Evaluating the impact of asset management in the water industry: A case study of East Rand Water Care Company (ERWAT)

by
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Declaration

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Abstract

Recently, asset management systems have been implemented within the public sector. Although the National Treasury developed a guideline for capital asset management in local government to assist with the development and implementation of the asset management system, the guideline has received very little attention. The Auditor-General's findings indicate a lack of proper implementation of the asset management process.

The study provides an indication of the implementation of the asset management process by most government entities, local government, municipalities and the public sector. The bottom line is that while most entities have made progress with regard to implementation, much remains to be done. Most entities implement the asset management process selectively. This does not yield positive and sustainable results and they end up abandoning the whole asset management system.

The report outlines the successful development and implementation of an asset management system at ERWAT and indicates the gaps that were identified as limiting the progress and success towards achievement of performance objectives. It reveals that if elements are missed or not addressed properly the process will not yield consistent results and the impact on the organisation's performance will not be positive. Performance measurement, which should be used to determine progress and implementation, should be linked directly with asset management. Service level agreements should be established between all relevant departments, including the finance department, and all stakeholders should agree on objectives. The key to proper implementation is the alignment of the asset management process with the strategic objectives of the organisation.

Opsomming

Verskeie batebestuurstelsels is onlangs in die openbare sektor geïmplementeer. Alhoewel die Nasionale Tesourie riglyne vir kapitale batebestuur in plaaslike regering ontwikkel het om die ontwikkeling van ’n batebestuurstelsel te ondersteun, het dit min aandag geniet. Bevindinge van die Ouditeur-Generaal dui op ’n gebrek aan behoorlike implementering van ’n batebestuurstelsel.

Hierdie studie ondersoek die stand van implementering van batebestuurstelsels deur die meeste regeringsliggame, plaaslike regerings, munisipaliteite en die openbare sektor. Die slotsom is dat terwyl die meeste liggame vordering met betrekking tot implementering gemaak het, nog baie gedoen moet word. Die meeste liggame het hierdie batebestuurstelsels net selektief toegepas. Dit lewer nie positiewe en volhoubare resultate nie, wat daartoe lei dat hulle die hele batebestuurstelsel laat vaar.

Die verslag handel oor die ontwikkeling en implementering van ’n suksesvolle batebestuurstelsel. Dit toon dat indien elemente uitgelaat word of nie behoorlik aandag geniet nie, die proses nie konsekwente resultate sal lewer nie en dit nie ’n positiewe uitwerking op die organisasie se prestasie sal hê nie. ’n Prestasiemetingstelsel, wat gebruik moet word om vordering en implementering te bepaal, moet direk aan batebestuur gekoppel wees. Diensvlakooreenkomste tussen al die betrokke departemente, met inbegrip van finansies, moet ingestel word. Daar moet ook eenstemmigheid oor doelstellings tussen alle belanghebbendes wees. Die sukses van die implementering van ’n batebestuurstelsel word bepaal deur die mate waarin hierdie stelsel in lyn met die strategiese doelwitte van die organisasie is.

Acknowledgements

I would like to acknowledge my family and friends who have assisted and supported me throughout my studies. I also like to thank ERWAT, who have provided me with the platform, data and information, provided by various departments, to do this project. Lastly, I would like to thank Prof. Johan Burger for his willingness to accept me as his student and to avail himself in the preparation of this report.

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CIP	Comprehensive infrastructure plan
CMIP	Comprehensive municipal infrastructure plan
CMMS	Computerised maintenance management system
COGTA	National Department of Cooperative Governance and Traditional Affairs
DWA	Department of Water Affairs
ERWAT	East Rand Water Care Company
IAMPs	Infrastructure asset management plans
IIMM	International Infrastructure Maintenance Manual
FDP	Facility development process
MFMA	Municipal Finance Management Act
MMS	Maintenance management system
NIMS	National Infrastructure Maintenance Strategy
OEE	Overall equipment effectiveness
PAM	Physical asset management
PPE	Property, plant and equipment
SADC	Southern African Development Community
SDBIP	Service Delivery Budget Implementation Plan
SLA	Service level agreement

CHAPTER 1: Introduction and Background

1.1 Introduction

East Rand Water Care Company (ERWAT) is an entity specialising in wastewater management and treatment. It is owned by the Ekurhuleni Metropolitan Council, Sedibeng Municipality and Johannesburg Metropolitan Municipality. Like many such organisations, ERWAT faces various challenges that affect the quality of water management. These are related to corporate governance, asset management and service delivery. Performance failures have increased stakeholders' demand for accountability, transparency and the ability to implement organisational strategy as approved by the Board of Directors. In addition, development and maintenance of governance requires capacity, resources and a performance measurement system. Recent media reports about wastewater management, acid mine drainage and river pollution in many municipalities have prompted government to develop and enforce strict wastewater licence conditions and compliance standards.

The newly established Green Drop certification and excellence audits have resulted in the failure of most municipality systems to meet the requirements for their licence conditions to manage wastewater. The Auditor-General's recent report pointed out that a lack of strict governance measures is the reason for failure of most municipalities to properly manage their resources and comply with the laws and regulations. Such discrepancies indicate the lack of understanding and capacity to integrate all organisational governance processes. The organisation, amongst others and of specific interest for this thesis, needs proper infrastructure asset management capacity and capability to enable it to meet the requirements for water quality standards as set out in the Green Drop certification. As expressed in the *International Infrastructure Management Manual* (IIMM), "the goal of infrastructure asset management is to meet a required level of service, in the most cost effective manner, through the management of assets for present and future customers" (IMESA, 2006:1.1).

The failure or lack of utilisation of infrastructure asset management standards means that assets are not being maintained to perform at the required level. This increases the risk that these assets will fail when they are needed most. It also creates problems with the equipment turnaround after it has been taken out of service, which impacts negatively on the

quality of treated water. The Infrastructure Asset Management Programme is a corporate project aligned with the National Department of Cooperative Governance (COG) and the national requirement to establish, implement and use a comprehensive infrastructure plan (CIP).

1.2. Research problem

ERWAT has implemented a number of asset management principles and maintenance plans over the last few years. However, the organisation has experienced poor performance results although these plans and principles were thought to be the solution to the asset management problems and asset reliability. Other problems associated with performance backlog and bottlenecks have been poor procurement and supply chain management, which negatively impacted on the implementation and maintenance policies that guide asset management. The number of plants attaining Green Drop certification has dropped. This has prompted stakeholders to question the organisation's wastewater management capabilities.

The major performance failures have been attributed to various stages of the maintenance process and a lack of understanding of asset management objectives. Some of the major performance criteria are that treatment plants should have proper maintenance plans, that they should not be operated over their designed capacity and that the compliance standards should be met at all times (on average above 90% of the time). There are a set of standards that each plant needs to meet with regards to effluent standards, chemical loading and hydraulic loading. That means that if the plant operates above said standards it will not qualify for certification even if it meets all other requirements. Asset management planning is one of the criteria used to measure performance and compliance of any water treatment company; however, ERWAT does not have that in place.

The organisation requires proactive asset management methodology to meet all the criteria for Green Drop certification. This requires a system that will evaluate the performance track record of all treatment plants and maintenance activities that have been implemented. Thus, asset management requires that the organisation's information systems are integrated. This is currently not the case, creating bottlenecks in decision making, reaction times and required approvals or authorisations. Each department uses a different system. For instance, the finance department uses the Great Plans system, the human resources depart-

ment uses the HR Focus system, the technical department uses the On Key plant maintenance system and the procurement department does not make use of any system related to their line of business.

1.3. Research question

The main research question is the following:

- How should asset management assist ERWAT to meet performance and compliance standards?

In an attempt to answer this question, the study also addresses the following questions:

- What is asset management?
- What are the key requirements for the proper implementation of asset management?
- What are ERWAT's shortcomings with regard to asset management?
- Can asset management be implemented in the wastewater management context?

1.4 Research objectives

The main aim of this research is to evaluate ERWAT's current asset management practices, compare it to standard operational requirements and evaluate key performance requirements. This will assist in establishing the gaps between system requirements and asset management requirements to enable the proper implementation and assist the organisation to achieve Green Drop compliance in all treatment plants.

The objectives of the research are:

- to conceptualise asset management and key requirements for the proper implementation of asset management;
- to evaluate the current asset management processes of the organisation and identify the problem areas that need to be addressed in implementing the asset management process;
- to develop a framework for the asset management process that will guide asset maintenance and replacement in line with the procurement plan; and

- to develop the process of measuring performance and reporting as part of asset management.

1.5 Unit of analysis

The unit of analysis is the ERWAT's performance results of the five major water and wastewater treatment plants, namely Waterval, Hartebeesfontein, Olifantsfontein, JP Marais, Welgedacht and Dekema. The research will use and analyse the ERWAT's performance results from the plants against the set performance standards. All the plants used to submit performance reports daily, weekly and monthly. A comparison was made between these reports and those submitted from previous months. These performance criteria were the standards developed and used to measure Green Drop compliance.

The ERWAT model will assist in developing proper systems and processes that can be used by other entities and Municipalities to ensure achievement of Green Drop certification and performance excellence.

1.6 Research design

A qualitative research design is used in this study. McNabb (2002) describes this research design as a set of non-statistical inquiry techniques and processes used to gather data about a social phenomenon; this could be words, symbols, pictures or other non-numeric records, materials or artefacts that are collected by the researcher. The research process used is inductive reasoning, which requires a collection of genuine supporting evidence which would lead to probable conclusions.

The study combines non-empirical and empirical data; existing information or data is utilised and analysed to conceptualise the witnessed situation regarding asset management. Data were collected as implementation continued and progress was measured to develop action plans; this involved audits, questionnaires and new performance data. The explanatory design is predictive in nature as it uses cases and historical information while also presenting predictive outcomes. Historical Green Drop reports, equipment performance data and compliance reports were used to create asset management plans and analysis. The design approach used is descriptive. According to McNabb (2002), the descriptive design is used to develop a snapshot of a particular phenomenon of interest; it provides a description

of/or defines behaviours being measured at a given time and the focus is to map out a situation or set of events to describe what is happening.

1.7 Research methodology

1.7.1 Methodology

The qualitative method was used to gather and process data and information and to construct the theory that will explain and predict asset management and Green Drop compliance. The relevant information about variables, available from documentation and databases, was used in the study design to establish relationships.

1.7.2 Data collection

Documentation on operational compliance and plant performance reports were used to describe, explain and analyse causal relationships. The content analysis technique provided the information required and assisted in extracting meaning from available information.

The sampling option or strategy used was theoretical sampling with purposive technique. It was done using the computerised management information system. New information about the maintenance and condition monitoring system and plant performance as well as procurement information and patterns was collected and stored. The study utilised qualitative interviews, audits and in some cases questionnaires to collect data.

1.8 Data analysis

The collected data were analysed and summarised to develop an action plan and measure the progress of asset management. The data are presented in the form of tables, charts and graphs. Various statistical tools were used to summarise information and establish meaningful relationships.

1.9 Chapter summary

The chapter provided the problems experienced by water and waste water organizations, the challenges regarding asset management. The need to have an integrated approach to asset management and the legislation governing the asset management were identified, the problem areas and challenges facing municipalities as expressed by the Auditor General

were provided, the aims of the research provides good platform and the process to assist other organizations implement proper asset management processes, the research methodology, data collection and analysis indicate a thorough processes to be followed while investigating the asset management process and implementation.

1.10 Chapter outline

The first chapter provide the context of the problem, identify the problem area that the researcher aims to answer, the problem objective and the methodology used to collect the information and analyse the collected data. The second chapter provides the asset management framework, models and literature review, while the third chapter describes ERWAT background, performance requirements and standards required for water and waste water management organization such as ERWAT. Chapter four presents the research findings, while chapter five describes the analysis, conclusions and Recommendations.

CHAPTER 2: Asset management

2.1 Introduction

Maintenance of infrastructure is not simply routinely doing the same thing and measuring the cost of doing business. Getting the most out of equipment during its productive life with minimum investment is the goal of every organisation. This chapter evaluates the literature on various asset management strategies and the most effective elements in designing a world-class maintenance management programme (Campbell, 1995: viii).

Asset management is a major component of Green Drop certification and also enables achievement of performance requirements; lack of plant maintenance, equipment failure and long turnaround of equipment disrupt performance outputs and result in raw sewerage polluting the environment. As reflected in section 63 of the Municipal Finance Management Act (2003) the scope and responsibilities for implementing asset management are clearly specified which include safeguarding and maintenance of asset according to GRAP and maintaining a system of internal control of assets and asset register. This requires annually in that municipalities account for their assets and manages asset registers, implement asset management processes, in order to ensure that proper budgeting and expenditure on assets are managed.

2.2 Asset management defined

The IIMM (IMESA, 2006) provides the following definitions:

- Infrastructure assets are stationary systems or networks that serve communities, and the system as a whole is intended to be maintained indefinitely to a specified level of service through continuous replacement or refurbishment of its components.

- Infrastructure asset management is the systematic and coordinated activities and practices through which an organisation optimally manages its physical assets and their associated performance, risks and expenditures over their lifecycle for the purpose of achieving its organisational strategic plan.

Infrastructure assets are all core assets which are essential for service delivery of municipalities and include: (i) water, sanitation, roads and storm water drainage, solid waste, electricity supply and community facilities, known as immovable property and equipment, and (ii) movable assets such as vehicles that are directly used in the delivery of the service (National Treasury, 2003)

The Asset Management Framework (2003:2–3) defines asset management as the process of guiding the acquisition, use, safeguarding and disposal of assets to make the most of their service delivery potential and to manage their related risks and cost over their entire life. Asset management activities are undertaken within an integrated governmental asset management policy framework. This requires assets to be managed meticulously through all phases of asset management. Accountability for the proper use of capital assets continues to be monitored through various government interventions and audits, including the Auditor-General, who audits the asset register and asset management process.

The Asset Management Framework (2003:12) identifies six elements of asset management, namely:

- Future economic benefits or service potential: The focus is on service potential rather than future economic benefits. This means that assets are used to deliver services and goods rather than to generate income.
- Control of assets: Control for economic benefits rather than physical inflows.
- Past transaction or events: Assets are recognised from the point when transactions or events transferred control to the asset owner.
- Probability criteria: The degree of uncertainty that future economic benefits or service potential associated with an item will flow from the asset.
- Measurement criteria: The reasonable estimate of the value or cost that could be derived or measured with reliability.
- Subsequent disbursement on asset, valuations or revaluation of asset.

Al-Barqawi and Zayed (2006:126) describe the challenges that municipal officials and engineers face in establishing and employing management strategies. For instance, it is difficult to know and evaluate the conditions and ratings of buried infrastructure assets, particularly water mains. Stakeholders expect that monitoring and rehabilitation strategies are employed to minimise the risks facing these assets.

According to Wang, Cheung, Lee and Kwok (2006:745) stakeholders expect that enterprises should be concerned about shortened product and equipment life cycles and global competition. These challenges demand robust methods for providing real-time monitoring and control, offering proactive responses to abnormal operation, understanding asset utilisation and capacity, and minimising the occurrence of downtime in plants and retaining valuable operation and management knowledge.

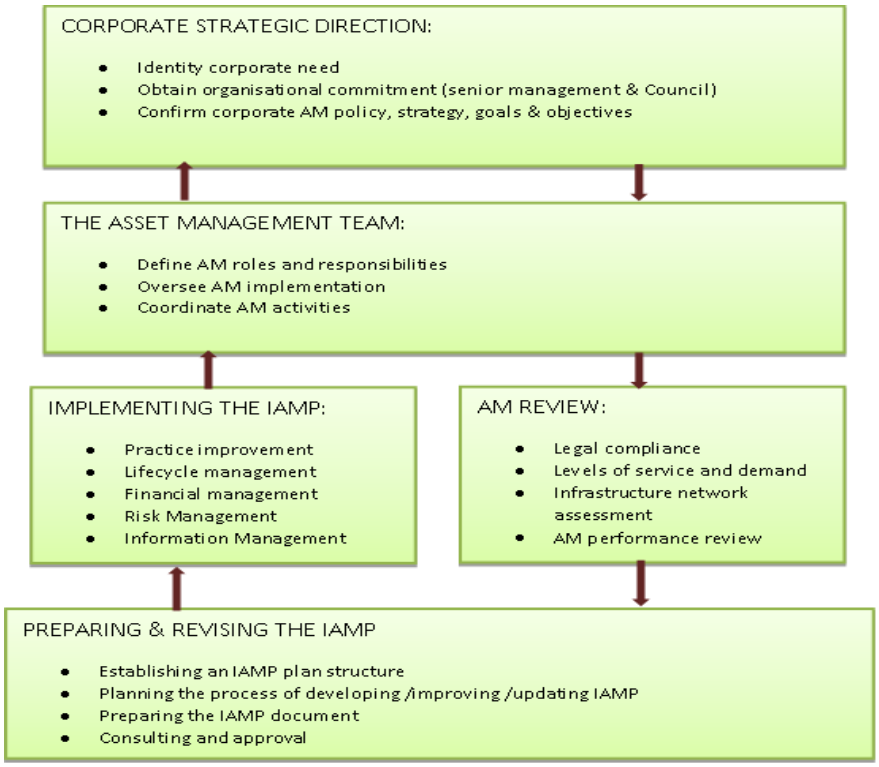
2.3 Asset management policy and management enablers

The strategic intent of the organisation should provide the platform on which asset management policy should be developed to address issues of asset management. Wang et al. (2006:746) add that the practice of physical asset management (PAM) is becoming more and more complex. Conventional PAM methods based on the measurements and failure rates of physical assets are not only inadequate but also reactive and provide scheduled maintenance only. These methods are no longer adequate to achieve overall enterprise efficiency. A system is needed that will provide automated, predictive and proactive maintenance services as well as achieve global knowledge acquisition and sharing. These can be achieved if the organisation has developed a policy on the basis of their strategic statement. Figure 2.1 below indicates the components required for an integrated asset management framework.

Source: National Treasury, 2003:24)

Figure 2.1: Asset management process

Figure 2.2 outlines the process of developing the asset management framework and all the requirements for the successful implementation of this process, starting with high-level development and including authorisations and consultations.



Source: *Asset Management Policy Manual* (2006)

Figure 2.2: Asset management programme

The enablers in this context are the tools, methods and processes that assist asset managers in managing their assets. The discussion and description of asset management offered by Wang et al. (2006:746) clearly indicate that traditional systems of asset management are no longer viable for current use and that these methods need to be complemented by information management systems. Bagadia (2008:25) describes asset management as the backbone of any organisation in which equipment must be maintained and believes that the company can save time and money with a computerised maintenance management system (CMMS).

> Business managers responsible for process manufacturing, operations, asset management implies the effective utilization of all assets within their operations to meet business objectives, optimizing plant assets to meet business objectives requires a holistic approach to asset management that goes well beyond the traditional focus of asset management software applications. (Fitzgerald, 2005:34)

According to Westerkamp (2006:37–38), "[t]he good system will indicate the number of work orders generated each week, track statistics of maintenance orders and estimate durations, labour hours per work order required and personnel required producing productivity results."

The asset management process ensures the reliability of assets. This directly affects wastewater quality and compliance with Green Drop criteria, compliance with effluent standards and meeting the requirements of wastewater management licences.

Water management refers to the water treatment and management process, in which quality of the treatment process is managed well and monitored, control measures are in place to ensure that treated effluent meets the required standards, and the treatment process at the treatment facility is heavily regulated. Contaminated water cannot be supplied to the public, so the stabilised and chlorinated water is placed in two separate reservoirs in order to be tested. If one meets the required grade, it is discharged back into the stream. (Sweet, 2011)

Water quality and environmental pollution are the major threats to ERWAT's operation and performance. According to Schulze (2011:621), poor water quality and environmental pollution are results of pathogens and organs from urban and rural areas which often derive from sewage effluent discharges into non-existent or dysfunctional wastewater treatment plants in many of the formal and informal areas. This results in high concentrations of *Escherichia coli* in rivers and stored water and often causes health problems.

Al-Barqawi and Zayed (2006:126) describe water delivery systems as being divided into two main categories, namely distribution and transmission lines. Transmission lines include the pipes that transfer water from the main source to the storage system, like water tanks. These constitute the most expensive part of the water network. The distribution line includes the pipes that carry water from the storage system to the users. These are made of various types of materials. The water infrastructure deteriorates and fails over time but the rate of failure varies according to the piping material and exposure to different environmental and operational conditions.

Asset management should include a process of measuring results and impact; this requires integrating resource management structure and organisation setting. Shiem-Shin Then (2003:35) proposes the following three processes for measuring impact of asset management, to model these requirements:

- The appropriate linking mechanisms for consideration by promoting dialogue between business planners and facility personnel.
- Assets must preserve their economic value, in terms of both exchange and use; the emphasis should be on the value of the assets in operational use required to support the fulfilment of production or plant operation.
- There have to be processes that manage and enhance the value of the asset to meet business objectives.

In improving service delivery, public entities facilitate service delivery to the public according to their mandate while ensuring financial accountability. Brady (2005:64) describes financial accountability and credibility as the traditional means by which a company's performance is judged; the company should have a strong historical and contemporary record for generating better than average returns for the shareholders.

A well-designed and integrated asset management system must have the potential to improve on organisational performance; the system should focus on functional improvement, which is improvement in the process of handling maintenance work and cost improvement (Westerkamp, 2006:39).

Pradhan (2005:51) describes asset maintainability as a concomitant part of reliability and an integral arm of asset management as it impacts on equipment uptime, which affects organisation performance. The use of asset management methods reduces mean time to repair and increases availability and performance.

According to Makansi (2004:216), performance serves as a hub for sharing best practices and leveraging the deep expertise at each plant. One of the goals of asset management is to develop and use a common language for reliability and maintenance improvement, which will translate into a common set of indicators which help to improve the discipline necessary to pursue performance improvement and maintain high levels of performance.

Asset management influences the success of any organisation either positively or negatively. If assets are maintained well, they will provide reliable and safe operation; the lack of maintenance will result in breakages, meaning that equipment will not be available for operations. The latter will add costs for repairs and replacement and result in a loss of revenue.

According to Qualline and Rabenaldt (2002:174), deficiencies that require other interrelated corrective actions offer the opportunity for collateral improvements. Some deficiencies can be corrected using maintenance and operations work orders while more involved correlations require capital or renovation funding. The cost for correcting the total assessed is deferred.

Westerkamp (2006:39–40) adds that functional improvement should result in cost savings on maintenance activities. Cost improvement is essential for long-term management and support. These types of improvements should be regarded as a strategic focus area and should be included in the organisational strategy. Process improvement and functional performance enhancement must provide focus and tangible goals with measurable expecta-

tions for every employee, and employees and management should be informed of performance results.

Cost improvement depends on the needs uncovered during the assessment of the current situation and determines the improvement potential. Companies indicate that maintenance typically contributes to about 10% of direct production losses (Moore, 2006:35). It is essential to define current asset performance in terms of several key high-level measures, such as overall equipment effectiveness (OEE), unit cost of production and return on capital.

According to Jacobs and Nienaber (2011:665), since water resources in the Southern African Development Community (SADC) plays an important role in regional development, it is a highly sensitive and complex issue that requires government to implement effective and equitable use and distribution. There are growing concerns about and awareness of the complex challenges facing water and cross-cutting impacts. This has led to the realisation that these challenges require integrated levels of ingenuity and expertise from a diverse set of actors working in a trans disciplinary manner.

Most importantly, asset management processes enable the maintenance department to measure and manage various costs associated with asset life and equipment operation. Tam, Chan and Price (2007:400–404) list four different types of cost that need to be considered during asset management, namely replacement, maintenance, equipment downtime and failure costs. At the end of the period the total cost associated with plant maintenance activities must include these costs. The focus should be on reliability rather than profitability since the main objective should be replacement rather than maximising profit.

Pandya (2011:4) emphasises the importance of developing performance management, enablers and criteria for measurement. He also explains that numerous studies have considered the implications of corporate governance structures as an enabler in company performance. Although the existing literature is not unanimous in its conclusions, the weight of the opinion is that there is a significant relationship between governance structures and firm performance.

A better corporate performance has been highlighted as the main benefit of adopting good corporate governance structures within the organisation in contrast to companies with poor

corporate governance. Companies which attach great importance to good corporate governance could show a higher shareholder value due to a higher cashflow and reduced cost of capital (Kraus & Bernd 2010:327–328).

While the Department of Water Affairs (DWA) has implemented compliance criteria, there is no alignment of asset management and compliance requirements. Asset management forms part of Green Drop compliance but there is no linkage or process provided to ensure that performance enablers such as procurement, information systems, funding requirement and capacity development are aligned to promote and enhance performance (Green Drop Report, 2008).

Bozec, Dia and Bozec (2010:686) illustrate the relationship between governance and performance. They explain that corporate governance normally reduces agency problems that arise from the separation between ownership and control by implementing mechanisms to monitor controls. Corporate governance tends to align with the interest of managers rather than with those of shareholders. This leads to higher operating performance since managers are stimulated to invest in projects with positive net present values and therefore the correlation between governance and performance is usually unanticipated.

> Whether it is strategy or policies that must be implemented, the vehicles for delivery generally take the form of projects and programs and effective project management is promoted as improving the ability to achieve outcomes while providing traceability, transparency and accountability. Developing and maintaining governance and service delivery capability through projects and programs requires investment and those responsible for project management implementation in organizations are regularly called upon to justify the investment. (Crawford & Helm, 2009:73)

> The institutions that manage water service provision in South Africa are rigid, inaccessible and slow to respond to changes. The standard project management style where project plan, timeframe and budget are fully defined before initiation and change is seen as a threat or as indicative of poor prior judgement leaves little room for innovation, creativity, experimentation and adaptability. (Hay, Goldberg, Hay & Lijnes, 2013:31)

2.4 IIMM framework and State Government of Victoria's asset management

Australia and New Zealand are the champions of asset management; hence the Victoria model is used as benchmark in the IIMM. The IIMM framework follows the framework applied in Australia (State Government of Victoria, 2004), which covers the following four areas, as detailed below:

- Developing an asset management policy
- Developing an asset management strategy
- Developing an asset management plan
- Details of the stages of an asset management life cycle

2.4.1 Developing an asset management policy

The asset management policy aims to address issues of service delivery on the basis of asset management. It informs decision making and incorporates the life-cycle process of an asset while integrating the needs, usage and future requirement of an asset. An integrated and multidisciplinary approach is recommended, highlighting required principles. The objective of an asset management policy should include possible benefits, such as:

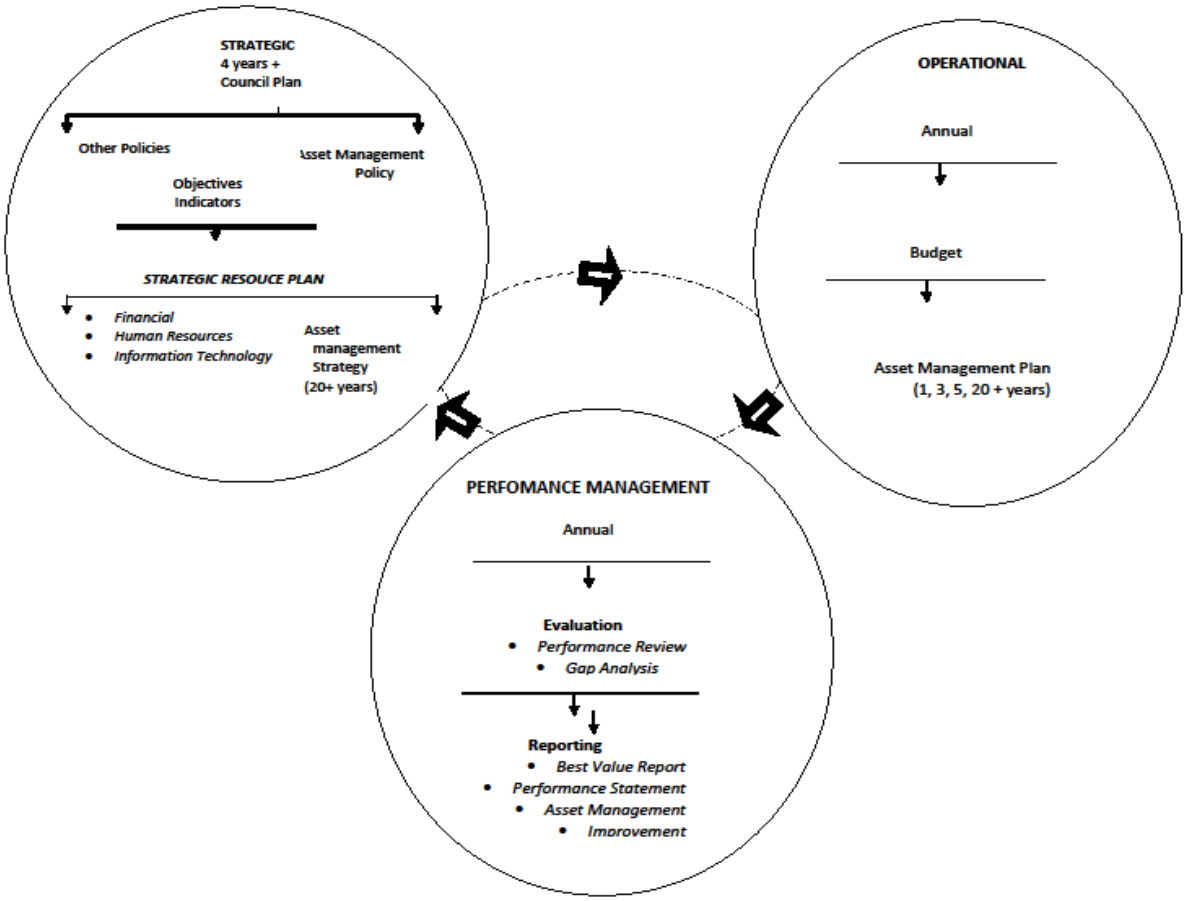
- Better allocation of limited resources
- Reduced demand of new assets through better integration of service planning
- Improved alignment of assets with services and community expectations
- More effective use and maintenance of existing assets
- Improved processes and accountability for capital and recurrent works
- Use of non-asset solutions to meet service demand
- Increased use of sustainable development solutions

The asset management policy should outline the following:

- Organisational context and importance of asset management
- Organisation's vision and goals for asset management
- Asset management responsibilities and relationships

- Broad timeframes and deadlines
- Integration of asset management into the organisation's business processes
- Audit and review procedures

In addition, the policy should outline at strategic level the organisation's service delivery objectives and requirements as well as the implementation plan, while at operational level these are converted into specific action plans through asset management planning processes which involve asset and non-asset alternatives. These should also include the process of monitoring and evaluating implementation, with clear parameters as set out in the asset management policy and strategy. The figure 2.3 below indicate the process of integrating asset management into organization strategy and turning it into an operational plan.



Source: State Government of Victoria (2004)

Figure 2.3: Planning framework

2.4.2 Developing an asset management strategy

An asset management strategy provides guidelines on how to align an asset portfolio so that it meets current as well as future service delivery needs.

2.4.2.1 Situational analysis

The initial strategic plan should provide a situational analysis of the current state of assets. The key elements of a situational analysis are the following:

- Current asset stock
- Condition of the current assets
- Operational and maintenance costs
- Utilisation of existing assets
- User satisfaction with service provision
- Future renewal profile

The requirement is to have a comprehensive picture of the procedures, systems and training in place. Procedures are needed for acquisition, operation and maintenance activities, renewal and disposal processes. All appropriate systems must be captured and recorded for monitoring and evaluation of performance management of all asset portfolios.

2.4.2.2 Asset management objectives

An asset management strategy must be aligned to the organisation's goals and objectives, and it must respond to demand for assets. The asset management objectives must address issues of where the organisation is aiming or going, as well as outline the expected outcomes, challenges and practices. The key elements for future considerations are:

- Unchanged outcomes
- New outcomes
- Outcomes that will cease to be met
- Broad information on changing demographics and industry
- Technological challenges

2.4.2.3 Asset management process

The asset management process should compare the current situation and the proposed future objectives and initiate the processes that will enable the organisation to meet these objectives. The asset management strategy should guide on matters such as:

- Increasing the effectiveness of the existing asset base
- Reducing the reliance on asset as solutions
- Seeking out new technologies to extend asset life

The process should convert asset management strategy into action through the asset management plan, which should be adopted and approved by the decision-making body of the organisation (State Government of Victoria, 2004).

2.4.2.4 Asset management planning

The guidelines for an infrastructure asset management in local government set by the State Government of Victoria provide the format for asset management planning adopted in the IIMM (IMESA, 2006:2-1). Both formats for asset management planning are similar, in that levels of service and future demand must be understood before the asset management plan is developed.

In asset management costing should be understood and should set the direction and purpose of the planning horizon. Strategy documents should also be aligned with the planning horizon of the organisation and should provide different planning times for different assets depending on the criticality, usage and priority of the asset.

2.4.3 Developing an asset management plan

The asset management plan is used to provide information about the asset condition and action required to provide a defined level of service in the most cost-effective manner. The asset management plan is based on the chosen timeline or planning horizon for the asset life cycle. The current asset condition as well as the future performance requirement is taken into consideration when activities and maintenance processes are designed.

The key elements of the asset management plan are:

- Defined service levels
- Defined timeframes
- Asset description
- Risk-management strategies
- Financial information
- Potential changes in asset condition
- Improvement programme

2.4.3.1 Defining service levels

The asset management plan should define the expected and required service levels; these are clearly defined by the IIMM as “defined service quality for an activity or service area against which service performance may be measured” (IMESA, 2006:2-1).

Maintenance refers to all actions necessary for retaining an asset as near as practicable to its original condition in order to achieve its expected useful life but excluding rehabilitation or renewal; this includes all types of maintenance which are corrective and preventative maintenance” (Drakenstein Municipality, 2010:35).

The plan should outline the purpose, scope, social context and legal framework of the plan as well as the approach adopted in preparation of the plan. It should also indicate the current and future targets of service and performance requirement.

Service levels are determined in consultation with stakeholders, which could be the community or customers. Some of the measurements that are used to determine service levels are:

- Quality
- Quantity
- Safety
- Capacity
- Fitness for purpose
- Aesthetics
- Reliability

- Responsiveness
- Environmental acceptability
- Costs

Changing customer demand and requirements influence the above measurements, requiring a continuous review of service-level measurements. Expressing and quantifying services in user terms help to examine the range of service levels which provide a good measure of the different levels of outcomes.

2.4.3.2 Asset description and planning horizon

An asset management plan generally requires different planning horizons, ranging from short to medium and long term. These can be described in years for planning and forecasting purposes. Factors affecting current demand and future expected demand must be identified, which should include predictions of demand variations and measure of certainty.

Asset description provides asset data used during planning. The information required includes:

- **Physical identification**: quantity, location, construction materials, year built, condition, capacity, performance as well as estimated remaining life.
- **Financial information**: original cost, renewal cost, replacement cost, service levels and expected performance.

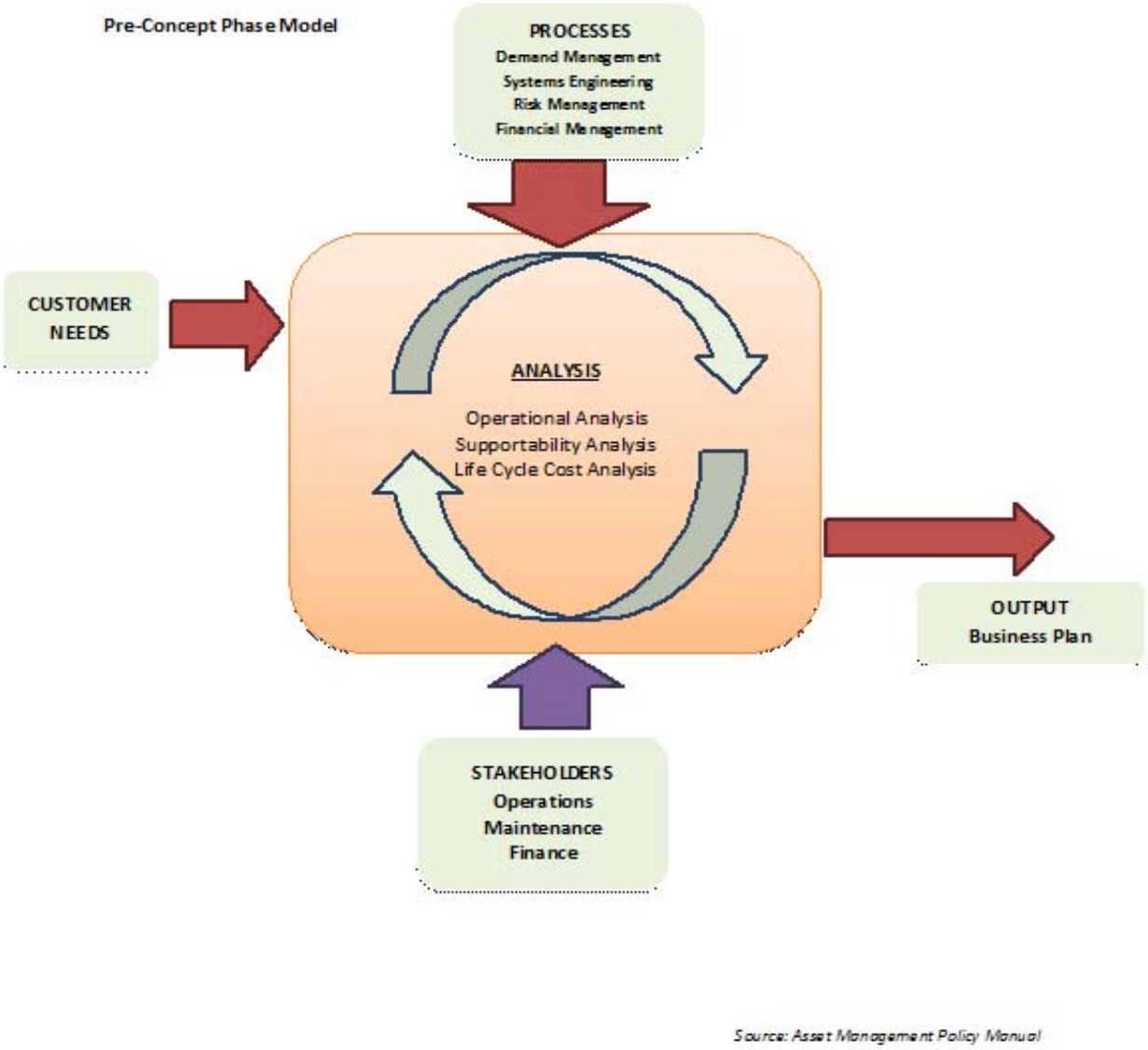
2.5 South African perspective on asset management

Assets are exposed to different risks as a result of service performance. These vary from political risks to environmental and financial risks. Some of these risks which could influence asset performance include:

- Natural events and environmental changes
- External impacts, including power supply failures
- Operational and physical failures risks

The asset management plan should incorporate various risk management approaches, critical assets and their risk measurements, assessments incorporating appropriate risk re-

sponses and plans to mitigate the occurrence of some of these risks. The plan should include a business continuity plan if the probability of occurrence is found to be high enough; this would be decided based on the organisation's risk profile. Figure 2.4 below indicates the process to be followed, South African local government through Treasury guide gives the similar process to be implemented in municipalities and the public sector in developing the asset management plan and how other stakeholders should be included in the development phase.

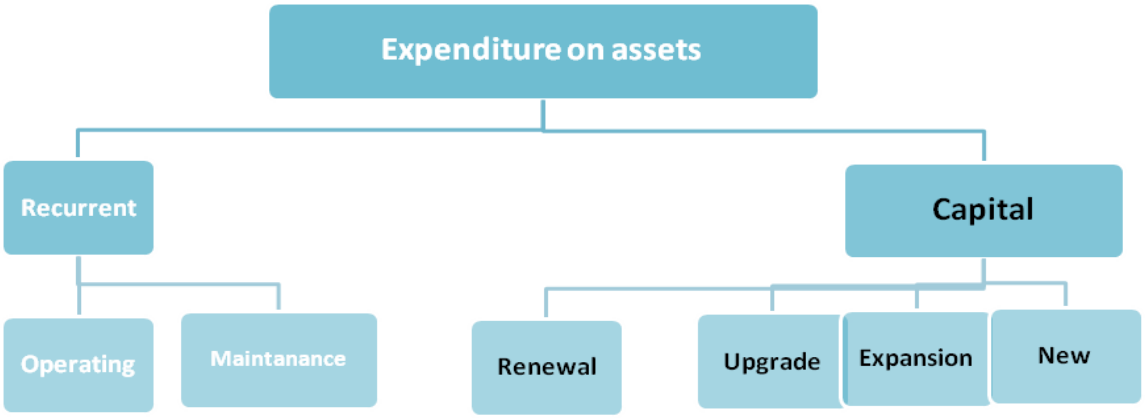


Source: *Asset Management Policy Manual* (2006)

Figure 2.4: Asset management strategy development plan

Financial estimates and cash flow forecasts should be included in the asset management plan; the financial information should incorporate all asset life cycle costs and cover both operation and maintenance, including capital expenditure. Different types of expenditure on infrastructure assets are categorised in Figure 2.5. The policy manual (Asset Management Policy Manual, 2006) discusses the process of financial classification and information on the asset register as indicated in figure 2.5 below: Provides clear links to asset management plan

- Provides unit asset costs
- Gives clear audit trails
- Recorded and prepared in real cost and cash flow
- Uses real discount rates consistent with investment analysis guidelines
- Assimilated into financial recording systems



Source: National Treasury, 2003

Figure 2.5: Classification of asset expenditure

Financial information assists with the preparation of annual financial reports, budgets and planning. Service potential describes, a decline in service potential is usually due to usage or age. Service potential, which is the output or service capacity of an asset, can change due to the following factors:

- Changes in service level requirement
- The impact of technical or commercial obsolesce
- Maintenance given to the asset
- Improvement in technology applied to maintain the asset

The likely changes in the asset condition include information about service potential. A decline in service potential is usually due to usage or age.

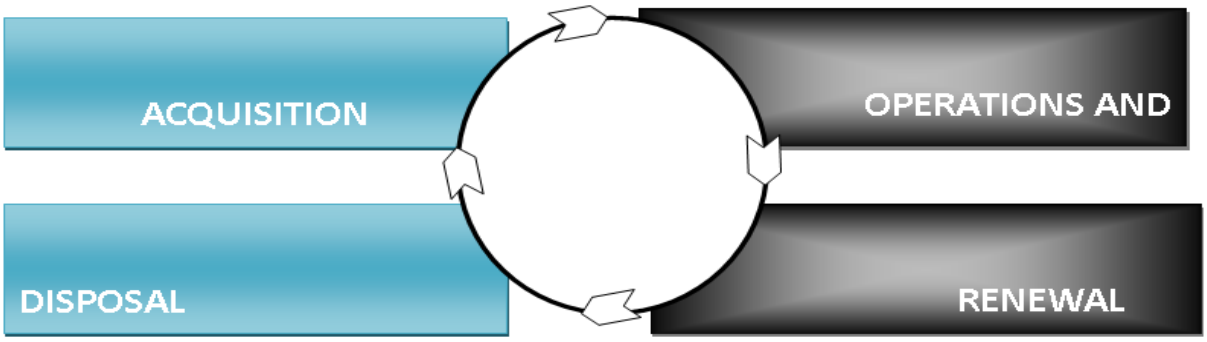
The asset management plan should include all assumptions and provisos under which it is prepared. It must indicate the confidence levels of the reliability of the data, accuracy of data and accuracy on condition of the asset and growth forecast. The remaining useful life and level of precision on the forecasts of renewal and maintenance expenditure for the asset must be clearly indicated.

Asset management plans should outline options and recommendations for necessary actions to improve procedures, systems, training, data, etc., for example:

- Improvement and sustainability targets
- Timeframe over which the improvement needs to take place
- Resources needed
- Contingency plan of action for critical and essential priorities if resource shortfall occurs

2.6 Common elements of the asset management life cycle

The asset management life cycle has common elements in all different models and they all incorporate four different phases (see Figure 2.6). These are acquisition, operation and maintenance, renewal, and disposal.



Source: State Government of Victoria (2004)

Figure 2.6: Asset management life cycle

2.6.1 Acquisition

The asset acquisition phase consists of six elements, which are discussed below.

2.6.1.1 Planning:

This element ensures that all steps being undertaken add value to the organisation, increase the asset life and operation output of the asset and ensure that the asset contribute to the goals and objectives of the organisation. Planning includes various stages and these are done in phases of the asset life to assist the organisation in:

- Setting levels for service delivery and performance requirements
- Evaluating the working condition of the asset
- Measuring the performance output of the asset
- Measuring the gap that may exist between output and requirement
- Evaluating funding options
- Capital budgeting
- Optimising maintenance and disposal processes

The planning process for infrastructure is better explained and described in the local government capital asset management guide as discussed above and also the development of Municipal infrastructure plan and how it must be integrated into the asset management plan to provide support for IDP. Figure 2.7 below illustrates some of these steps, it also indicates how various infrastructure asset management plans (IAMPs) feed into the Compre-

hensive Municipal Infrastructure Plan (CMIP). The latter draws on information from the IAMPs and provides support to the IDP process.

Source: National Treasury, 2003)

Figure 2.7: Consolidated IAMPs and CMIP process

2.6.1.2 Coordination and integration:

- Spatial issues
- Programmes
- Technical issues
- Practice improvements
- Prioritisation
- Affordability

The development of a CMIP should be a consolidation of the planning process and present the strategic issues and key information from the plans in a simplified format to enable decision making. The focus of asset management planning is to:

- give clear understanding of the critical areas and needs;
- consider short, medium and long-term life cycle cost implications;
- give rationale behind each planned activity or project;
- ensure correct investment and financial decisions; and
- give budget implications on asset functionality.

2.6.1.3 Assessments of requirements:

This element involves asset analysis and evaluation of the current condition to determine future requirements and interventions. The assessment is done against a set of expected requirements to enable decision making and good judgement. Appropriate and effective asset management planning depends on the long-term strategic objectives that must be translated into action plans. Strategic asset requirements include existing needs as well as short, medium and long-term needs supported by the financial capacity of the organisation. (National Treasury, 2003: 67)

The Guidelines recommend that the following steps are followed in order to ensure that the correct asset management process is developed:

Feasibility report: This provides a sound basis for decision making. It evaluates the best option between various available options regarding the acquisition of an asset and provides the basis for asset specification and scoping. It gives a detailed report of the demand for an asset and assesses different environmental, economic, social and other factors that need to be assessed that may influence the asset's functionality and life cycle.

Acquisition/construction: The approval of the specification and scope leads to the decision to choose the best option of asset to acquire or construct. The decision also indicates the type of asset, the utilisation or intention and the decision whether the asset will be acquired for permanent or temporary use (short or long term). The next step will then be the construction or acquisition.

Asset identification and recording: This step involves the asset register, which has become a requirement for all public entities to ensure a correct asset list. Municipal councils and public entities are custodians of various asset portfolios for which they are accountable. They are required therefore to keep an updated register of assets for reporting purposes. The method used to identify and record assets should conform to the regulatory and statutory requirements provided by Treasury. (National Treasury, 2003)

2.6.2 Operation and maintenance

"This is the utilization stage that includes all the processes that enable the cost effective operation and maintenance of assets within an environment of continual improvement. It also includes implementation of asset management plans developed either during or subsequent to acquisition." (Policy review, 1995: 4-3).

The processes of defining support requirement for assets during their operation and maintenance should include existing assets and future acquisitions. All aspects of the asset management process require continual improvement to achieve and retain the required levels of performance in a competitive market. Various management processes are utilised to develop the standards to be used:

- Certification process to some of the adopted assurance standards and quality management.
- Evaluation of monitoring and performance standards, performance indices and improvement programmes.
- Benchmarking and industry analysis.

The asset maintenance management plan focuses on maintenance issues and takes into consideration the expected outcomes. Maintenance considerations involve the following:

- Planned maintenance (routine/preventative maintenance)
- Unplanned maintenance (corrective maintenance)
- Information management
- Asset valuations
- Reassessments

Different assets require different timeframes for maintenance. These are guided by the usage, type and condition of the asset. To develop the maintenance plans for assets requires an understanding of the asset conditions. The following are the different maintenance processes being applied and used for asset management life cycle enhancement:

Planned maintenance: Throughout its life stages, the asset requires maintenance to support and maintain its functionality in order to ensure that it performs as required. Some of the

assets come with manufacturer's specifications and schedules that specify the types of maintenance and support required at certain stages, but most require condition monitoring and interventions depending on the condition and life stage.

The utilisation of a maintenance management information system is required to ensure accurate and correct historical information about an asset. The development of planned maintenance schedules involves multidisciplinary teams and approach; the planning requires understanding of resources required to execute these maintenance plans, which include tools, equipment, plant and people. It is critical to ensure that maintenance schedules and intervals are correct; these will minimise maintenance costs.

For an asset to retain a certain level of performance, continuous support and improvement are required because of the high performance requirement and the high competitive environment some of these assets operate under.

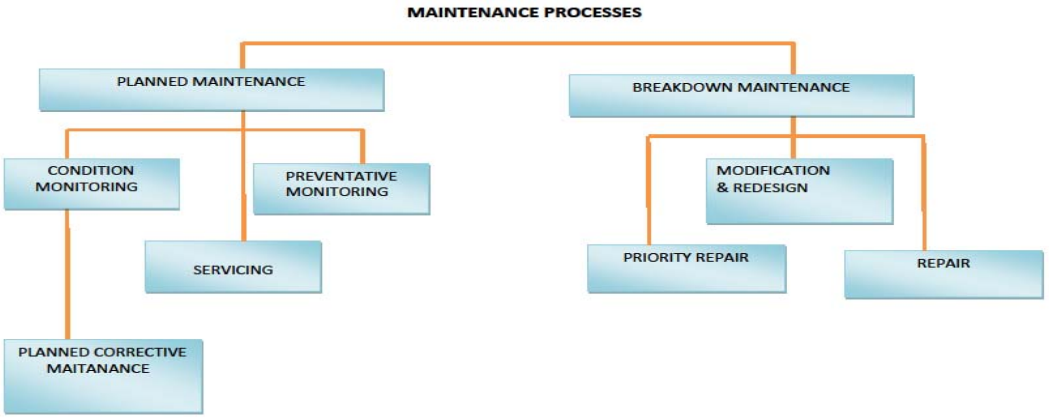
Corrective maintenance: Asset failures consume resources and affect productivity. It is therefore essential that provision is made for enough resources in the event of failure to ensure corrective action to put the asset back into operation as soon as possible. Some of the corrective action planning is done to minimise damage. Events in which asset failure could have a catastrophic effect or disruption of service delivery include:

- Risks management
- Disaster recovery plans
- Contingency plans
- Business continuity plans

Repair and rehabilitation: The New Mexico Environmental Finance Center (2009:38–39) recommends various stages that assets should go through, including repair; it indicates systems that should be considered as well as the period an asset should be kept in service prior to repair or replacement, which should be balanced. The resources that are spent on assets would increase on average over time and usage. A balanced analysis of the cost of repairs and replacement should be done, and assets should be monitored and the decision to repair or replace made when appropriate.

"

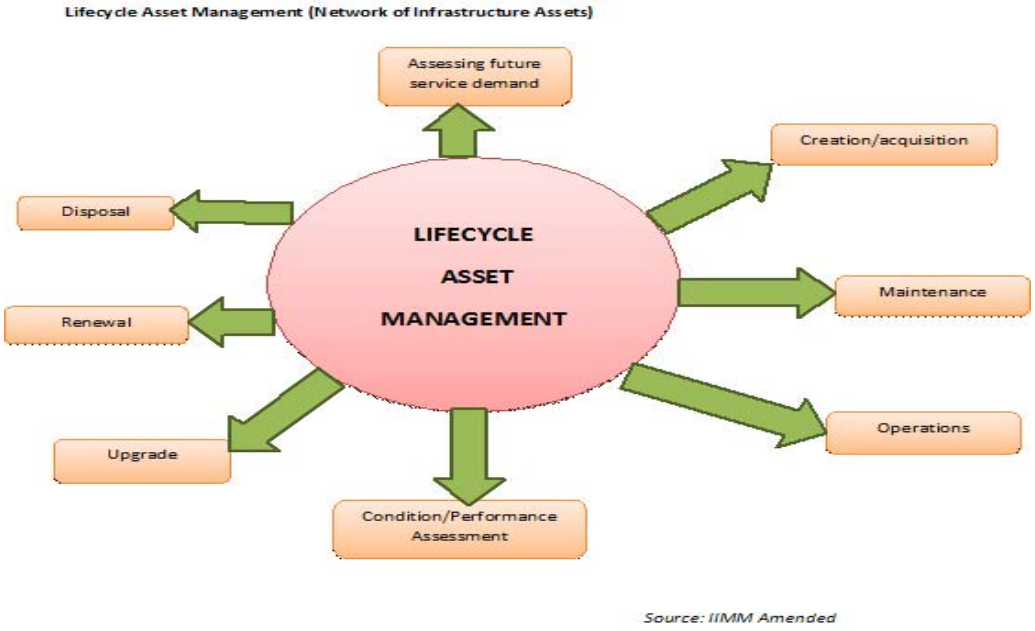
Record and information management system: It is required by law that all information, asset registers or records must be kept and regularly updated for all assets. Maintenance records form part of asset management records as they indicate the maintenance and asset support provided to the asset and also make it easier to determine the expected life and replacement requirement for the asset. The asset information provides valuable inputs into the maintenance activities for the asset and also inputs into the planning (National Treasury, 2003) Figure 2.8 represents various maintenance processes that can be followed in developing infrastructure maintenance plans and activities.



Source: National Treasury, 2003

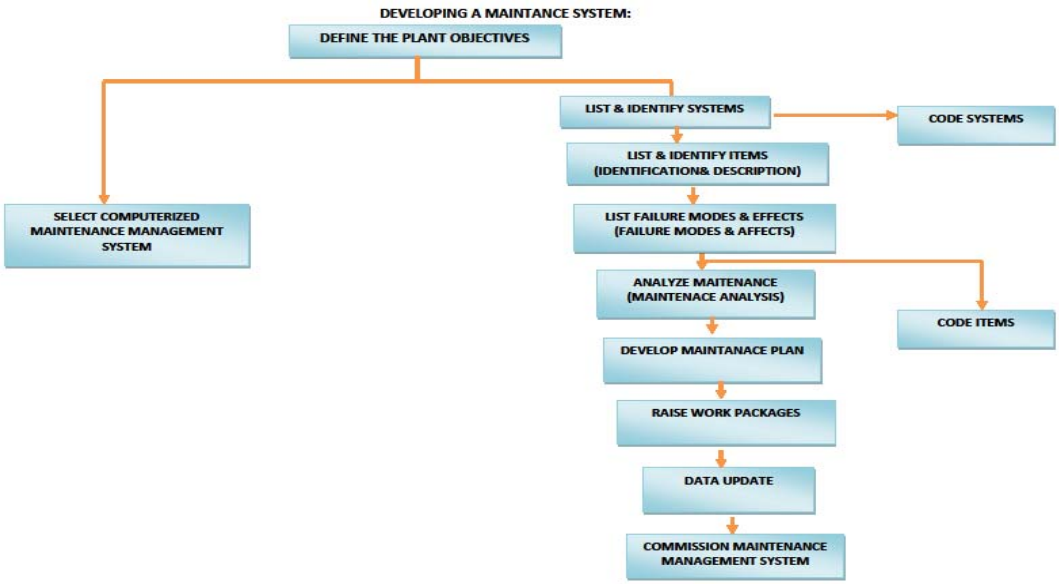
Figure 2.8: Maintenance processes

Figures 2.9 and 2.10 provide representations of the stages of the asset management life cycle and the development of a maintenance system respectively.



Source: IMESA (2006)

Figure 2.9: Asset management life cycle stages



Source: National Treasury, 2003

Figure 2.10: Maintenance systems development

2.6.3 Renewal or upgrade

According to the *Guidelines for infrastructure management* (2006–2009:1–8), renewal's objective is to keep assets functioning at its full, original capacity and repairing the structural damage or failures in the system that are a result of wear, corrosion, age and/or construction-related damage, with the aim of reducing the risks of system failure that could cause interruptions in service, have negative impacts on the community and increase costs compared to a scheduled maintenance and repairs process.

2.6.4 Disposal

Sections 14 and 90 of the Municipal Finance Management Act of 2003 (MFMA) as well as supply chain management regulations such as regulation 27636 inform the disposal process of capital assets. These stipulate that the municipality may not permanently dispose of a capital asset needed to provide the minimum level of basic municipal services, and that the municipality must determine and assess the specific ability of an asset before it can be transferred or impaired. The process of transferring asset ownership must be fair, equitable, transparent, competitive and consistent with the municipality's supply chain management policy (National Treasury, 2003).

The MFMA's *Local government capital asset management guideline* (National Treasury, 2003:43) provides the guidelines and processes that have to be followed by the municipality if it considers disposing of an asset. The asset must be identified as underperforming or no longer functional and suited for basic service delivery needs and other possible use should be considered before deciding to dispose the asset.

> All assets identified as redundant, obsolete and unserviceable shall be reported by the asset manager to the Chief Financial Officer and the report shall detail: full description of the asset; the asset code; location of the asset; the condition of the asset and the reason or cause for the obsolescence or redundancy. The disposal off the asset shall be at the market value by the tender auction, trade in, write off and donation whichever is most advantageous to the state. (DPWRT, 2011:9)
>
> In accordance with GAMAP 17.70 property, plant and equipment (PPE) shall be eliminated from the statement of financial position on disposal or when the asset is permanently withdrawn from use and no future economic benefits or service potential are expected from its

> disposal. Any gains or losses from the retirement or disposal of an item of PPE are calculated from an estimated net disposal proceeds when the amount of carrying an asset has been subtracted. (Amatole District Municipality, 2007:26)

2.7 Chapter summary

Asset management provides the management processes that assist organisations with managing and accounting for their assets. Legislation requires accounting officers and responsible managers to ensure that the guidelines provided by Treasury and other approved policies are developed and implemented to ensure asset management. The objectives of asset management is to ensure that assets meet the required level of service in the most cost-effective manner by implementing various strategies to ensure that service potential is realised.

Literature provides various definitions, objectives and mechanisms of asset management, as well as suggestions on the implementation of asset management in organisations such as ERWAT. This would ensure that ERWAT meets the requirements for wastewater and effluent standards even though the demand for and cost of water and wastewater management keep increasing. In the following chapter, ERWAT case study of asset management application, how this influences the current objectives and quality requirement.

The IIMM and Australia's State Government of Victoria model suggest similar processes of developing and implementing asset management. These indicate that for asset management to be successfully implemented there should be a formal process of developing the framework within the organisation which should be linked with the organisation's objectives. The South African perspective also displays elements in common with the international framework; although Treasury developed the model based on the IIMM the broader framework is similar to the Australian model.

CHAPTER 3: ERWAT case study

3.1 Introduction

ERWAT is a municipal entity, which means that it is governed by the Municipal Systems Act, 2000 and the Municipal Finance Management Act, 2003 (MFMA). These acts require that the accounting officer submit performance and measurement objectives to the Municipality outlined in the Service Delivery Budget Implementation Plan (SDBIP) at the beginning of each financial year to ensure that performance is in line with performance objectives. Most municipalities and utilities are working to improve their performance and are aligning their processes to ensure that water and waste management systems meet the performance requirement. They have done so by creating systems to measure and analyse their performance. These systems use monitoring and evaluation processes to measure the quality, quantity and targeting of the goods and services (outputs) that the state provide as well as the impacts resulting from these outputs. Various systems are used to facilitate the understanding of the causes of good or poor performance.

This chapter investigates the general challenges that ERWAT faces as well as the process used by the Department of Water Affairs and Forestry to assess the organisation and to measure compliance levels. It also examines ERWAT's implementation of asset management and the impact of asset management on the organisational performance in water and wastewater treatment.

3.2 ERWAT's asset management

ERWAT adopted and implemented its asset management principles in 2009. The aim was to align all maintenance and infrastructure management activities with the government requirements adopted as the National Infrastructure Maintenance Strategy (NIMS) in 2006 (IMESA, 2006:1.2).

The idea behind the implementation was to ensure effective output of the operating environment of the physical assets and increased availability and reliability through a systematic analysis and alteration of the physical assets. The responsibility for such effectiveness is held by management, operations and the maintenance system. The desired effect of this pro-

gramme is an increased production capacity of the assets, without the requirement of additional capital asset investment. The current operating conditions of these assets imply that there should be a consistent and intense maintenance system to ensure minimal failures. The wastewater treatment process is very corrosive to equipment due to chemicals that are used, the operation demand and the age of the equipment. Most of the plants operate at an average of more than 100% design capacity which increases the risk of failures for these equipment (see Figure 3.1 below).

Maintenance management and infrastructure programmes form the foundation of compliance audits and Green Drop certification that are conducted on a regular basis to monitor plant performance and the level of compliance with licence conditions. The high number of equipment out of service puts pressure on the plant's operation and compliance standards and there is an urgent need to evaluate whether the current maintenance systems contribute positively or negatively towards plant performance.

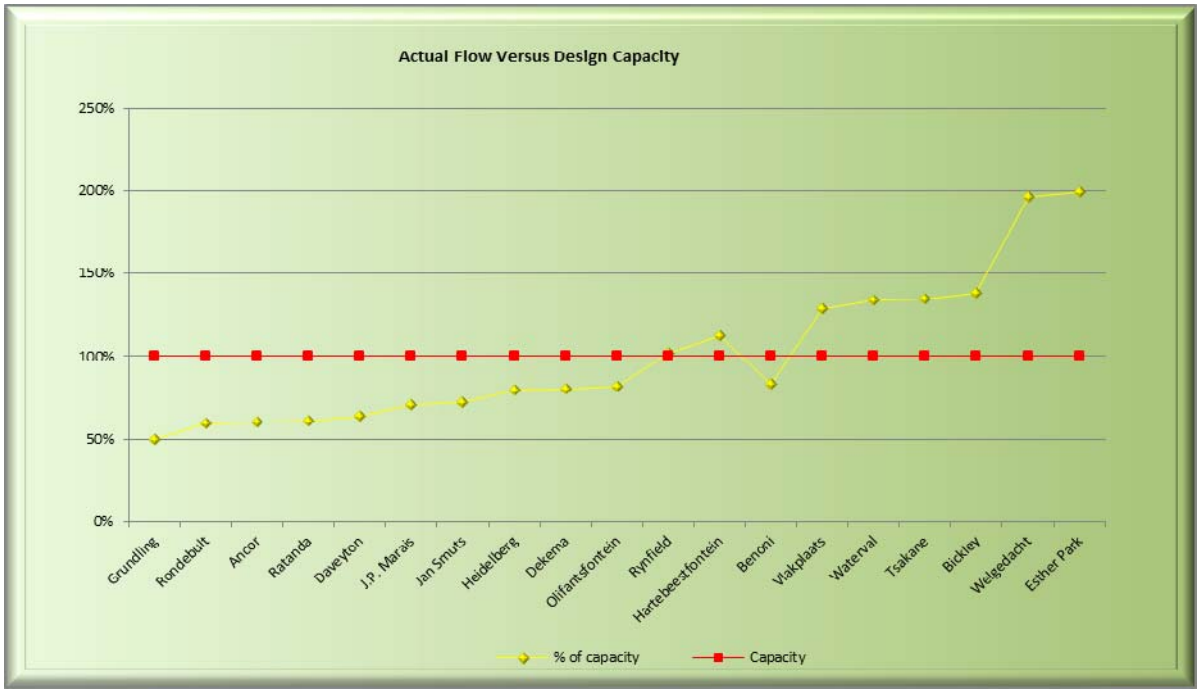
The annual Green Drop assessment requires that the organisation provide maintenance plans with activities and competencies of the various teams responsible for maintenance management. The scores given in the technical assessment are given on the adequacy and impact of maintenance services in ensuring that all assets are maintained correctly and that risk is minimised and reliability and availability of equipment is increased.

3.3 ERWAT's performance

Since the implementation of the maintenance and procurement system or supply management system (SCM), plant conditions have not improved and the backlog of equipment has increased. This has negatively affected the compliance level of the plants. Between 2009 and 2011 organisational performance has dropped from attaining organisational performance excellence in 2009 to three plants achieving Green Drop compliance in 2010 to only one plant receiving Green Drop certification in 2011 (see Figure 4.3 and Table 4.2).

Not only has the organisation's performance seemingly dropped based on Green Drop certification but the performance requirement has also increased. The performance reports represented in Figure 3.1 indicate that the majority of the plants are operating above their design capacity. This shows that as an organisation, ERWAT is not meeting its mandate and

performance objectives of ensuring that there is always capacity to process wastewater, which is what the stakeholders expect.



Source: *ERWAT Annual report* (2013: 87)

Figure 3.1: Actual flow against design capacity of ERWAT plants

The fact that the majority of plants is operating beyond their design capacity indicates the challenges faced by the organisation and technical department due to the high probability of equipment failure. Plants operating beyond their design limits also reduce the possibility of them meeting their quality standards as retention is less and treatment duration is shorter than required due to high inflows.

3.4 ERWAT compliance and challenges

The Department of Water Affairs has been using stringent effluent quality compliance measures to measure performance in wastewater management. Different plants have different compliance standards that apply depending on the environment in which the effluent is discharged. General plant compliance is affected by the following:

- Implementation of incident management protocols at the plants
- Refurbishments and repairs of some plants or lack of capacity

- Optimisation of treatment processes

Various processes have an impact on the overall compliance of the treated effluent, ranging from how the plant is operated to the availability of critical equipment at the plant. There could be different reasons why certain equipment is not available, such as:

- Delay in equipment repairs
- Delay in the approval process
- Delay in the procurement of equipment
- Delivery lead times
- Budgeting process or lack of budget

The Green Drop assessment implemented by the Department of Water Affairs poses challenges for public sector entities and municipalities in that there are various criteria that must be met in order to attain the minimum Green Drop score of 90% in order to qualify for certification. The assessment requires that the entity meet the required criteria in all of the following areas (Department of Water affairs, 2011:17–21):

- Asset management
- Treatment capacity
- Monitoring programme efficiency
- Effluent quality
- Submission of quality results
- Process control.
- Maintenance and management skills
- Risk management
- Bylaws and enforcement

Each of the above elements carries a certain weight or percentage of the total score; there are also penalties which may total 5% and bonus points which may total a maximum of 17%.

3.5 Assessment criteria for maintenance management

Green Drop assessment focuses on the maintenance activities performed at the specific plants. It also considers the information system feedback or information credibility and usability to enhance maintenance processes. The required information on maintenance activities includes maintenance schedules (routine/schedule) as well as logbook entries which can serve as proof of maintenance done.

The scheduled maintenance activities performed are compared with original equipment manufacturer's maintenance manuals (OEM manuals) or specifications of the plant equipment, reference drawings as well as operation schedules to check if the maintenance activities are in line with specified requirements. If the assessor is satisfied that all the performed maintenance activities match the required levels of service and the performed activities have been verified, the relevant score is awarded proportional to the level of satisfaction.

3.6 Chapter summary

Legislation requires ERWAT to implement asset management and the Green Drop assessment tool, which utilises the asset management process to measure, assess and implement the water and waste water management processes. If implementation is not in line with approved Treasury guidelines penalties are applied; the score reflects the level of implementation and compliance. This chapter indicates the elements of asset management that are required to contribute to water quality and compliance levels, including maintenance policy, maintenance plans and implementation.

CHAPTER 4: Research findings

4.1 Introduction

This chapter provides the findings on ERWAT's implementation of the asset management process. It looks at how asset management has been implemented and reviews the alignment of the asset management process with the strategic planning of the organisation. The chapter also evaluates if the asset management process has had any impact on ERWAT's compliance, performance management process. Moreover, the chapter provides a comparison between work activities before the implementation of asset management in 2010 and after its implementation. Finally, this chapter evaluates the impact of issues related to asset management, specifically the maintenance process, on organisational performance.

4.2 Findings on strategy alignment

This section provides findings on the procedures followed in implementing asset management within the organisation. The section also considers the guiding strategy of the organisation and the linkage between organisational strategy and departmental strategy.

4.2.1. Organisational strategy

ERWAT's strategy, developed and approved in 2011, emphasises the attainment of Green Drops certification for all treatment plants and the financial sustainability of the organisation. The main focus was ensuring that within five years all treatment plants comply with all the requirements for Green Drop certification. However, the following challenges were identified: the plans for attaining Green Drop certification by 2015 existed only on paper; there is no clear plan that will ensure that the strategic objectives are realised; the organisation did not change any of its processes, including drafting the budget, procurement processes and planning between departments.

The strategy was rather ambitious and it was not supported by any budget or funding. The majority of the plants are very old and operated using the old technology. Almost seven out of 19 plants are operating above their design capacity, although operating within design capacity is a requirement for Green Drop certification. Yet there are no plans for those plants to be upgraded except for Welgedacht, Waterval and Herbert Bickley. The alignment be-

tween organisational strategy and other stakeholders who are impacted by the operations of the organisation was not clear. There was no plan to address the issue of ensuring that plants that are operating beyond their capacity are resolved to ensure green drop compliance, increase capacity of the plants. No timeframes were indicated, nor the expected construction period, sourcing of funding, or interaction between the organisation and major shareholders to ensure sustainable capacity, the existing Facility development model does indicate capacity requirement but looks rather reactive than proactive, the budget estimates are far behind the requirements.

Plant construction requires timely planning. Construction takes more than three years; if the organisation's objectives of attaining 19 Green Drop certifications by 2015 were to be realised, most of the construction, especially on the plants operating beyond their design capacity, should have started.

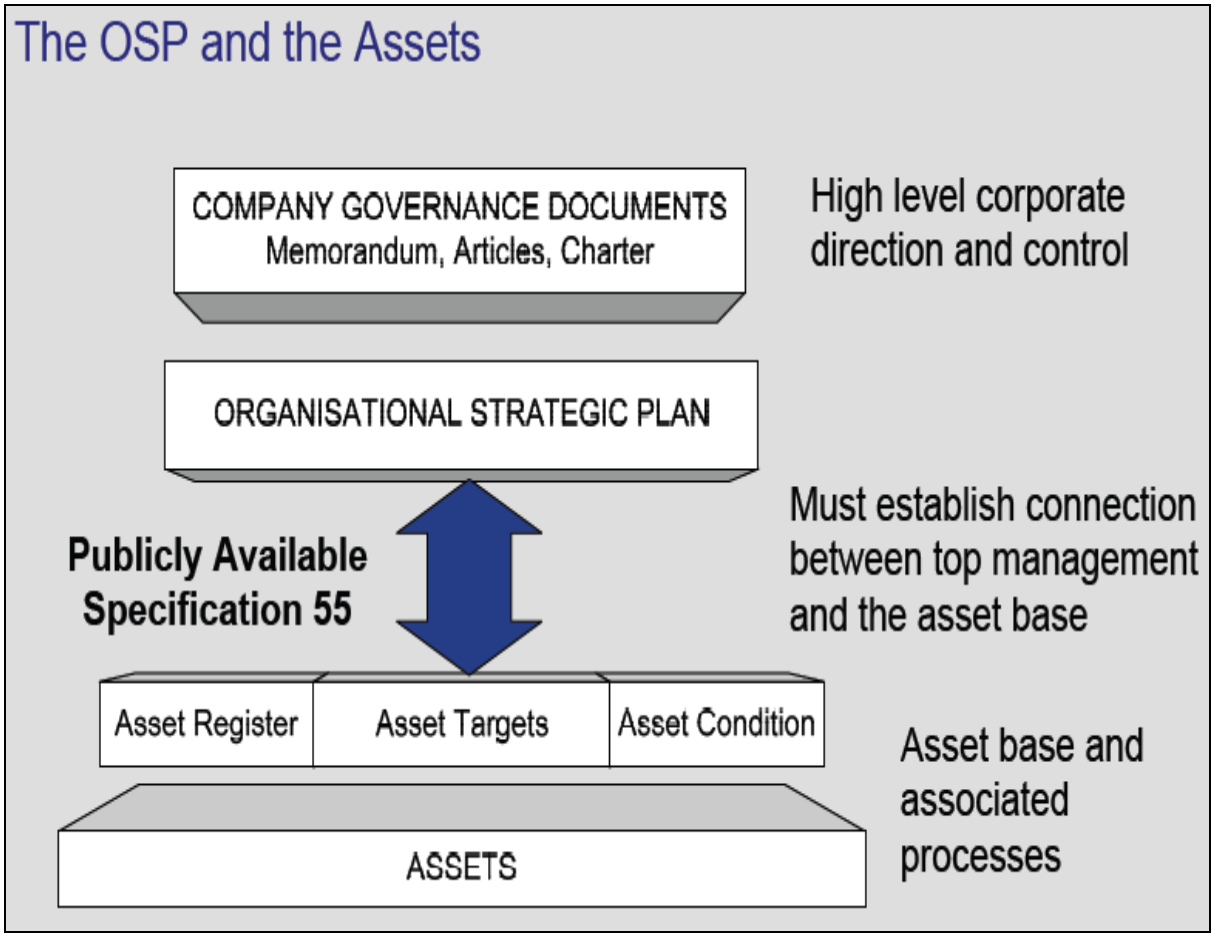
Most of the organisation's policies were outdated and others have not been officially approved by the Board of Directors. These include the risk management policy, physical asset management policy, safety management policy and other policies critical to the implementation of the strategic objectives.

4.2.2 Departmental strategy

The success of the organisational strategy depends on the infrastructure department to ensure that there is enough capacity and that the entire infrastructure is adequately maintained. This would require a substantial increase in the maintenance as well as the construction budget.

The infrastructure department's strategy includes activities such as equipment audits and demand analysis. During the audits it was clear that this exercise would take longer than the requirement of the strategy (estimated completion is 2016) due to budget constraints. This indicates misalignment between strategic objectives and reality. The departmental budget indicates that many vacancies required for some of the activities will be filled over a period of three years, which also shows misalignment with strategic objectives. The asset management policy used has not been officially approved by the Board of Directors, which creates confusion, presents a risk to the department and impacts on asset maintenance im-

plementation. Figure 4.1 below indicates what this alignment and the linkage between strategies, organisation plan and asset management should look like.



Source: IMESA (2006)

Figure 4.1: Strategic alignment

4.2.3 Alignment with other departments

The infrastructure department requires assistance from other departments to ensure that all requirements are met. It also assists the operations department by maintaining the infrastructure to the required standard and expectation. There must be a service level agreement (SLA) between various departments, including operations, supply chain management, finance and human resources, as all these departments provide support to the infrastructure department. Currently no SLA exists between departments. Although meetings between the technical and operations departments do take place regularly, there are no structured meetings with other departments.

The strategic statements and objectives of other departments are aligned with those of Operations and Technical but only on paper. In reality there is no clear procedure of communication or discussion, even during the budgeting process.

There are two infrastructure departments, each using a different process to manage infrastructure. Maintenance uses an asset management system while Capacity Development uses a facility development process (FDP) to manage and prepare for current and future capacity requirements. The fact that different processes are used entails risk to the organisation and contradicts Treasury guidelines regarding infrastructure asset management in local government.

4.3 Green Drop performance

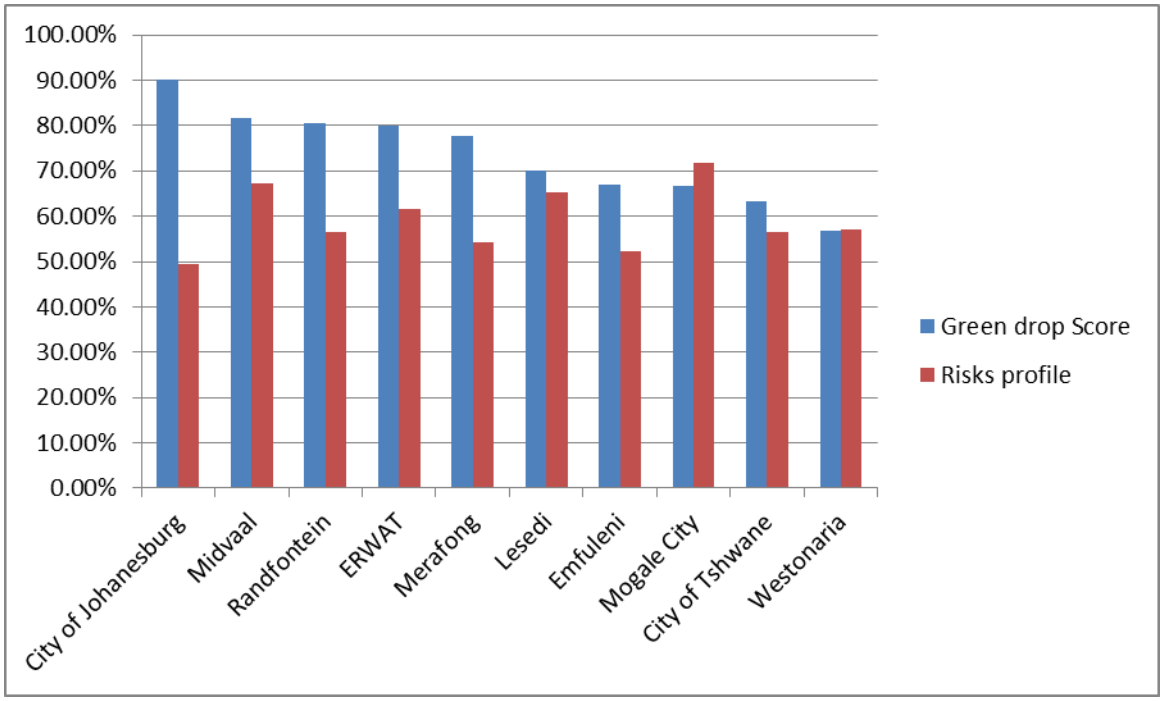
4.3.1 Overall Green Drop results

Green Drop performance for the last three years is presented below. Table 4.1 presents the comparative analysis of Green Drop scores with other utilities and municipalities and Figure 4.2 the position of ERWAT compared to the other Gauteng municipalities.

Table 4.1: Green Drop comparative results and risk profile

Municipality	Green Drop score	Risk profile	Position on performance	Number of works
City of Johannesburg	90.20%	49.40%	1	7
Midvaal	81.70%	67.30%	2	4
Randfontein	80.40%	56.50%	3	1
ERWAT	79.90%	63%	4	17
Merafong	77.80%	54.20%	5	5
Lesedi	70.20%	65.30%	6	4
Emfuleni	66.90%	52.20%	7	3
Mogale City	66.70%	71.70%	8	3
City of Tshwane	63.30%	56.50%	9	15
Westonaria	56.80%	57.10%	10	1

Source: Water Affairs (2012:22)



Source: *Water Affairs* (2012:24)

Figure 4.2: Green Drop scores and risk profiles

Figure 4.2 above represents only Green Drop performance measured against set criteria. The comparison is done without taking into consideration work distribution, flows and size of works. As seen in Table 4.1, some municipalities have few plants and others many.

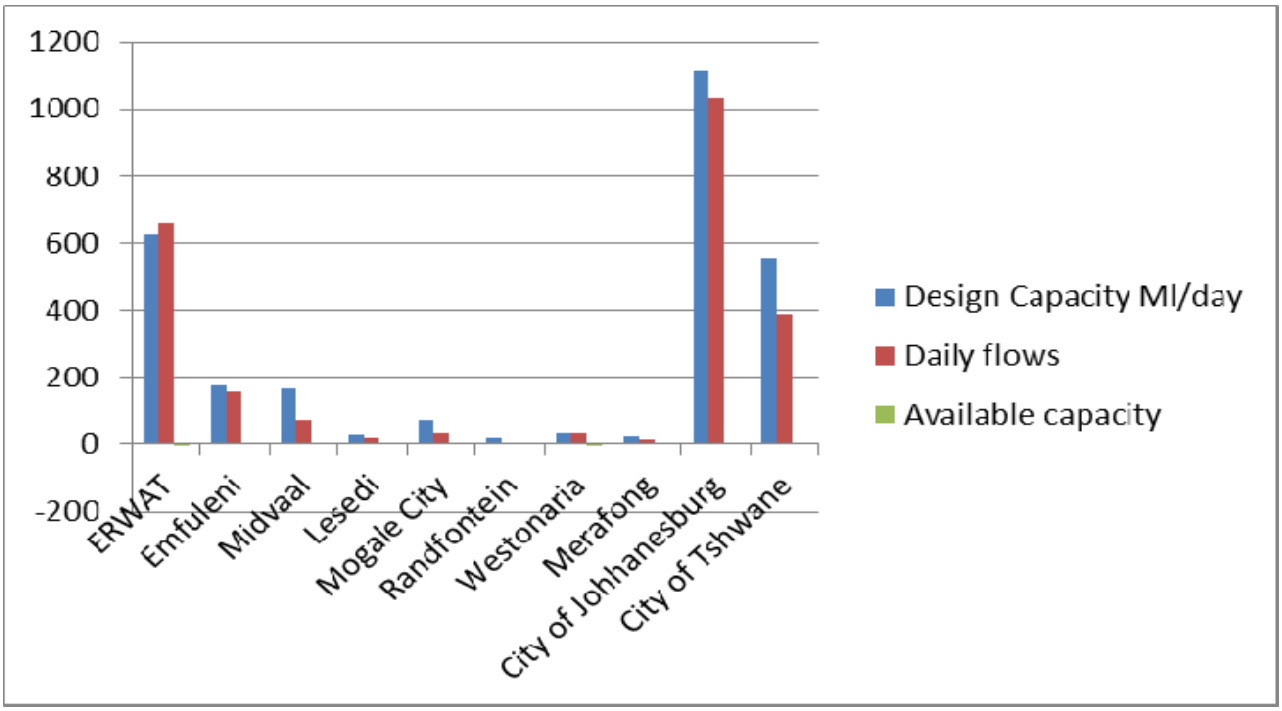
Table 4.2 and Figure 4.3 below indicate the size of the works in mega litre per day of processing wastewater as well as the average daily flows and the capacity of the treatment facilities. This indicates the available capacity as well as the urgency of maintenance processes in cases where plants are overloaded and do not have capacity available.

Table 4.2: Distribution of work

Municipality/Company	Design capacity Ml/day	Daily flows	Available capacity	*Number of works*
ERWAT	624.9	658	-5.25%	*17*
Emfuleni	177	159	10%	*3*

Midvaal	167.3	71.6	57.19%	*4*
Lesedi	25.5	19.3	24.20%	*3*
Mogale City	75.1	36.5	51.33%	*3*
Randfontein	19.5	0.2	99%	*1*
Westonaria	30	39	-30%	*1*
Merafong	22.5	13.3	41%	*5*
City of Johannesburg	1113	1031.9	7.29%	*7*
City of Tshwane	555.9	389.5	29.90%	*15*

Source: Water Affairs (2009:34)



Source: Water Affairs (2011:29)

Figure 4.3: Design capacity and daily flows

4.3.2 Performance results of five major plants

The performance of ERWAT's five major treatment plants is presented in Table 4.3 and Figure 4.4 below.

Table 4.3: Performance of five major plants

	Green Drop performance (%)		
Plants	**2011**	**2010**	**2009**
Hartebeesfontein	77	81	55
Olifantsfontein	79	79	55
Dekema	98	90	100
Welgedacht	64	71	55
Waterval	96	84	79

Figure 4.4 represents the five plants' performance and Green Drop scores over the three-year period 2009 to 2011.

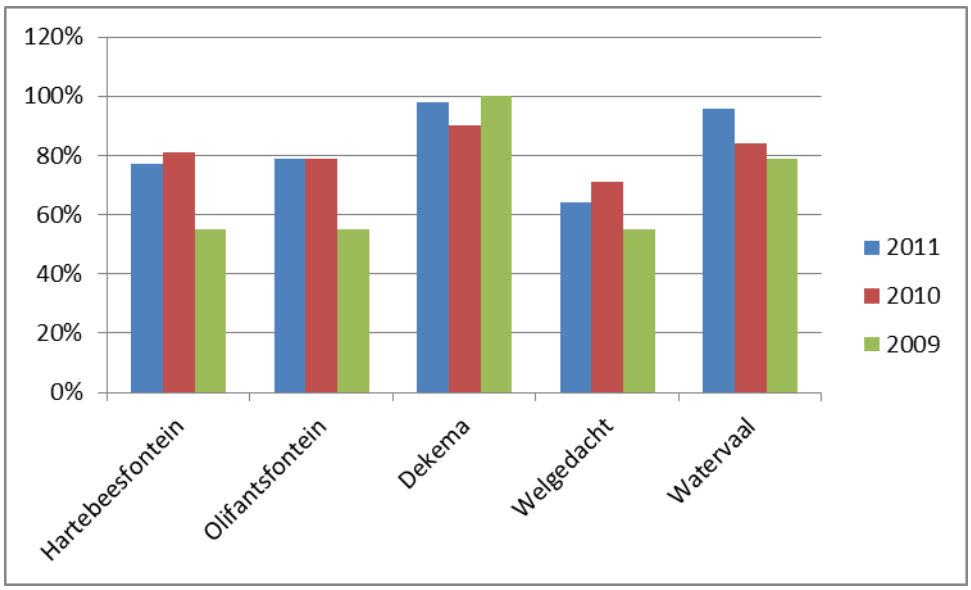


Figure 4.4: Green drop scores for five major plants, 2009–2011

4.3.3 Maintenance intervention

Figure 4.5 indicates the level of preventative maintenance activities between 2010 and 2013.

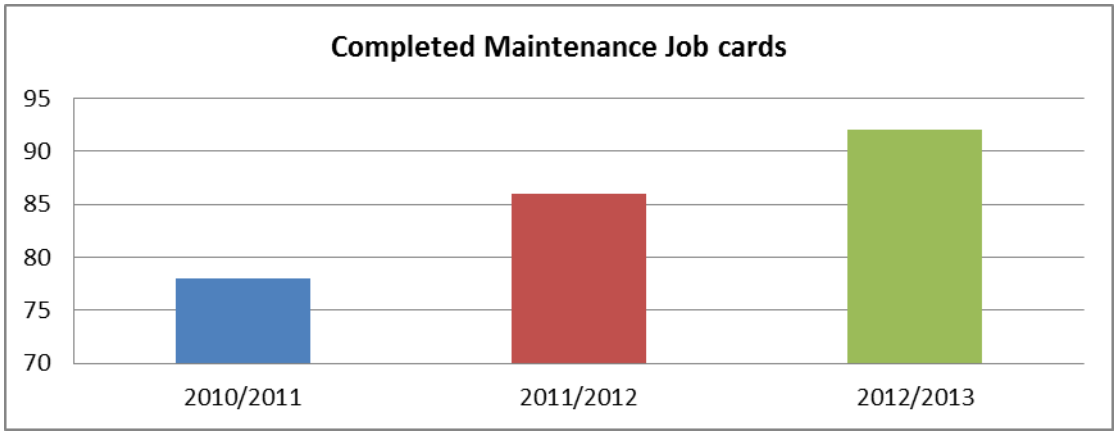


Figure 4.5: Completed preventative maintenance job cards (%)

Figure 4.6 indicates the compliance levels over the same period.

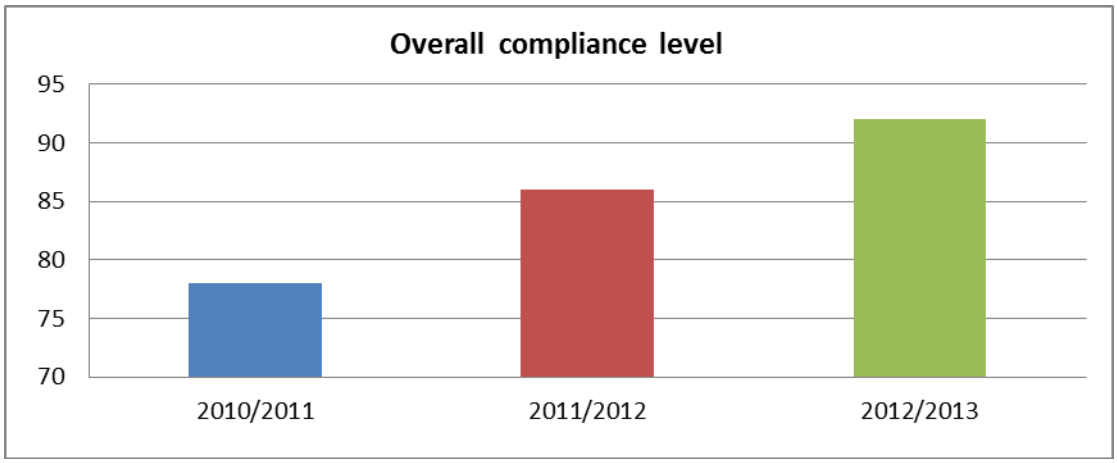


Figure 4.6: Compliance levels (%)

Figure 4.7 represents the number of failures reported over the same period. This gives a good indication of the overall compliance and makes it easier to compare the impact of maintenance planning implementation.

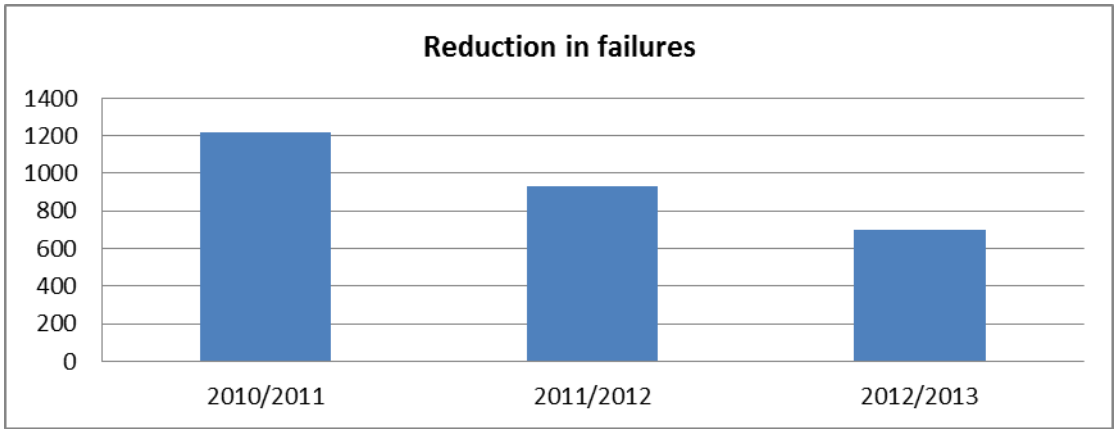


Figure 4.7: Number of reported failures 2010–2013

Figure 4.8 indicates the budget spent on maintenance-related activities between 2010 and 2013.

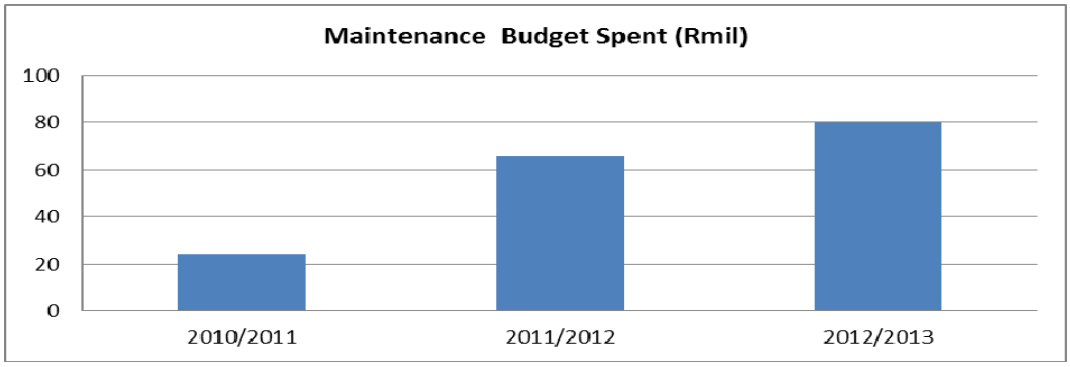


Figure 4.8: Maintenance budget spent (R million)

The graph shows a steep increase in maintenance spending; over the period there was a more than 100% increase in maintenance budget spent every year.

4.4 Findings on the asset management process

4.4.1 Maintenance management system (MMS)

ERWAT uses a system called On Key as CMMS. On Key's core purpose is to manage the asset register and asset condition and to facilitate work order transactions and activities. This involves the utilisation of the CMMS to facilitate and coordinate maintenance activities. The system ensures that maintenance teams and all resources are efficiently and cost-effectively utilised while sourcing of required spares and equipment is computerised.

The evaluation focused on the administration, implementation and use of the maintenance management system. The aim was to establish the usage, functionality, job card generation and procedures used. The following findings were made:

On Key has about seven modules, which include:

- Asset manager
- Maintenance scheduler
- Asset depreciation
- Maintenance manager
- Materials manager
- Asset care developer
- Asset identification and assessment

Currently only three modules are being utilised, namely the asset register, asset care developer and maintenance manager. This indicates that the system is currently used far below its capability.

The asset register module enables the company to build and maintain the asset register and ensure that it is kept up to date. However, the comparison of the asset register on the system and the one being managed by the finance department indicates many discrepancies. The current register on the system is outdated and insufficient, old assets still appear on the asset list while they have long been decommissioned and assets that have been installed have not been updated and entered into the system. The assets on the system lack details such as functionality, location and asset numbers, and the list is inconsistent.

The maintenance manager functionality on the system should provide users with the capability to manage maintenance activities and the platform to control, plan and manage flow of work activities, including scheduled corrective maintenance. Users could also develop historical information of assets for future decision making.

The materials manager module enables the optimisation of inventory, transactions and all processes associated with materials and spares. The audits indicated that currently there is

very little utilisation of this functionality, which directly affects material management and inventory control.

4.4.2 Inventory management

The poor utilisation of the materials manager module creates delays in procurement of spares and equipment as the department does not have inventory of spares that is kept for emergencies. Every time there is a failure, a new job card has to be created to order the material, which adds to the delay in response and repair times.

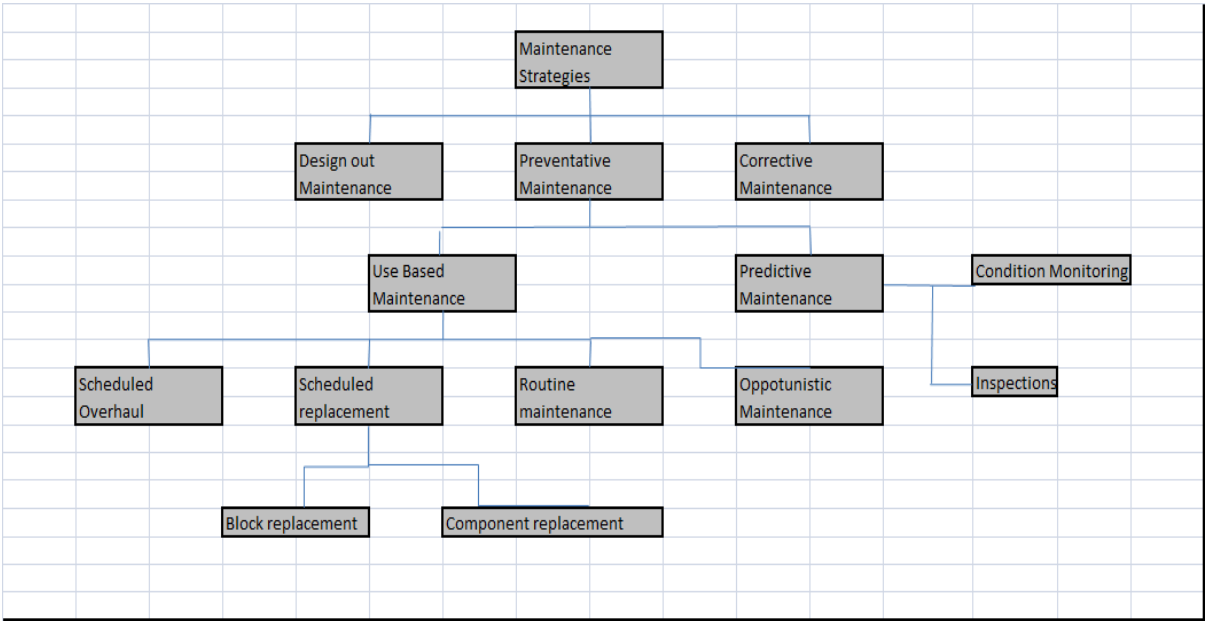
There are no proper records of the material on hand. Some of the inventory could be utilised better if there are records but currently each supervisor or manager keeps his or her records of inventory or material while someone else could be requiring the same material in another region.

4.4.3 Incident reporting

The current system of incident reporting entails raising a job request through the On Key system by Operations or any person requiring assistance. While this is the correct process, poor follow-up on incidents, which emanates from poor reporting and management procedures, means that at the time incidents are reported there is no responsible person to ensure that reported incidents are corrected in time and that feedback is given to the client. Therefore an incident stays in the system for a long time. There is also poor classification of incidents; most of the incidents are classified as urgent because of poor management or lack of proper implementation.

4.4.4 Management procedures

ERWAT's ageing infrastructure requires regular and sustainable maintenance procedures to ensure availability, reliability and safe operations. This would require well-planned and well-implemented maintenance processes backed by a CMMS to assist maintenance managers in implementing these processes.



Source: Campbell (1995:89)

Figure 4.9: Maintenance types

Over the years different types of maintenance have been implemented at ERWAT. These types are represented in Figure 4.9 above, which shows where each type fits in with the asset maintenance process which is based on the Treasury's guidelines on Infrastructure management in Local Government and the International Infrastructure Maintenance Manual.

The maintenance management processes need to be implemented as given and captured on the system accordingly. However, there are indications that the CMMS is either not properly used to facilitate maintenance processes or maintenance activities are not correctly planned and captured on the system. The system audits indicate that many job cards have not been closed properly on the system although the work has been completed, and that sometimes work is not completed although work orders are closed, which wrongly indicates that the job requests have been done.

4.4.5 Scheduled maintenance (preventative)

The operation of treatment plants is influenced directly by the availability and reliability of infrastructure. Criterion 1 for Green Drop certification states that operations require a qualified maintenance team and the implementation of maintenance schedules. Most of ER-

WAT's plants were built more than 20 years ago; their operation highly depends on regular maintenance to ensure that they are always reliable and available.

While preventative maintenance has increased, proper maintenance management is required to ensure that the system is used to add value to the maintenance teams and to provide them with valuable information. The maintenance schedules are automated and given to the maintenance supervisors on a monthly basis. At the end of the month the feedback is loaded onto the system. However, there were a few incidences where the schedules were not completed and these incomplete jobs were not rescheduled; instead they were closed as completed on the system, building wrong data base.

The maintenance team were also not properly resourced to perform all the required tasks, which was the reason for the poor completion of preventative maintenance schedules. Figure 4.10, which represents planned maintenance jobs from 2002 to 2009, indicates that planned maintenance has increased in order to prevent ageing equipment from failing regularly.

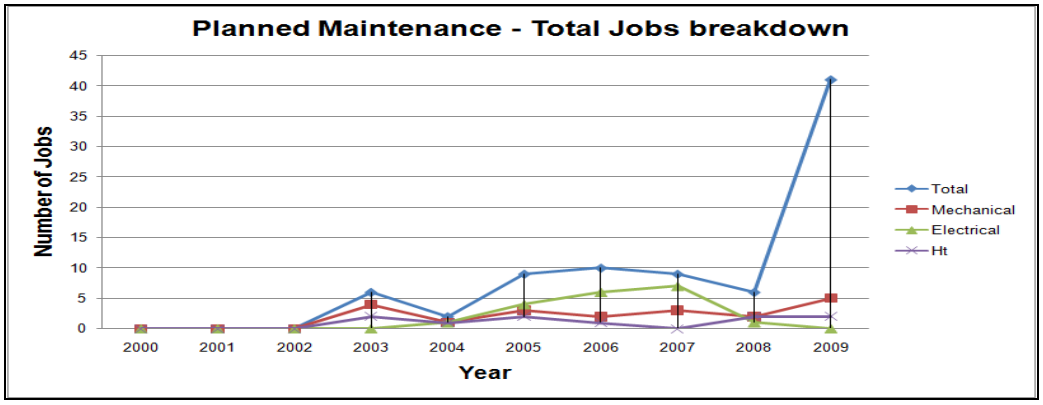


Figure 4.10: Planned maintenance jobs

4.4.6 Corrective maintenance (repairs)

Green Drop criterion 1 also requires that equipment failures and breakdowns are reduced; this is because failure of critical equipment has an immediate impact on effluent compliance while the long turnaround time of equipment results in not meeting the effluent standard. The information available from On Key indicates that the average turnaround time of the department was reduced from 135 days in 2010 to 63 days in 2013, as indicated in Figure 4.11 below.

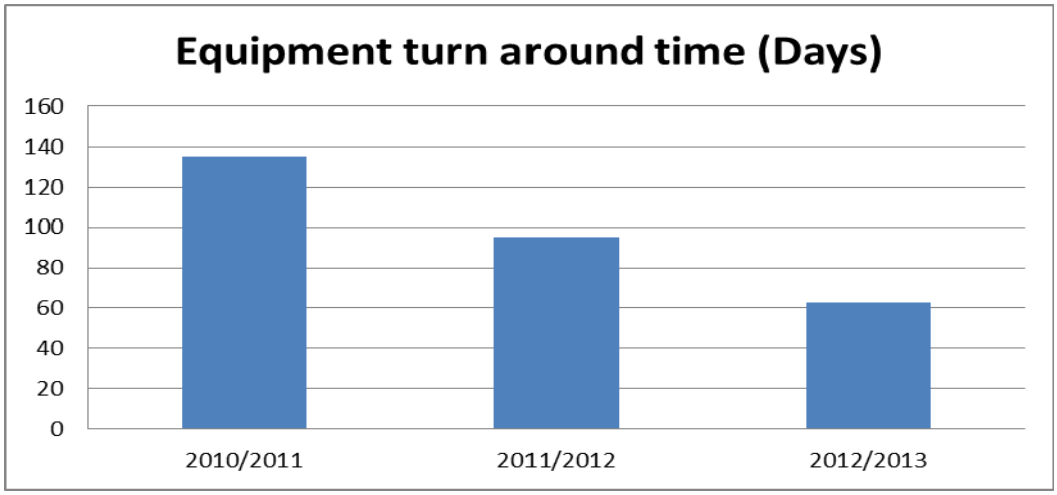


Figure 4.11: Average turnaround times of equipment

The equipment turnaround time is measured by the department. However, it was found that the accuracy of the data could not be verified with the receiving department of operations because there is no agreed-upon process of measuring strategic objectives.

4.5 Competency and capacity management

The uncertainty and lack of understanding of most of the applicable technologies including CMMS, requires that organisations use techniques with a high level of accuracy in their forecasting, but this requires skills and competencies that most organisations are lacking. Capacity management entails more than just implementing training and developing programmes. ERWAT does not have individual development plans (IDPs) for most of its technical staff and other employees in other areas of the business. Although a few IDPs exist, they were found to be very generic. In addition, they are not comprehensive as they do not address the critical component of skills development which would assist the department in achieving its strategic objectives. Furthermore, there is no process in place to monitor progress and skills level. Budget constraints were cited as the issue affecting the proper implementation of IDPs.

4.6 Comparing data before and after implementation

This section compares work before and after asset management was implemented in 2010. Each plant was evaluated and compared based on information that was derived from On Key. The cost of planned maintenance for major equipment is set out in Figure 4.12. Clearly

planned maintenance was not consistent; it increased between 2000 and 2003 and decreased until 2007, when no activity took place or the information was not recorded.

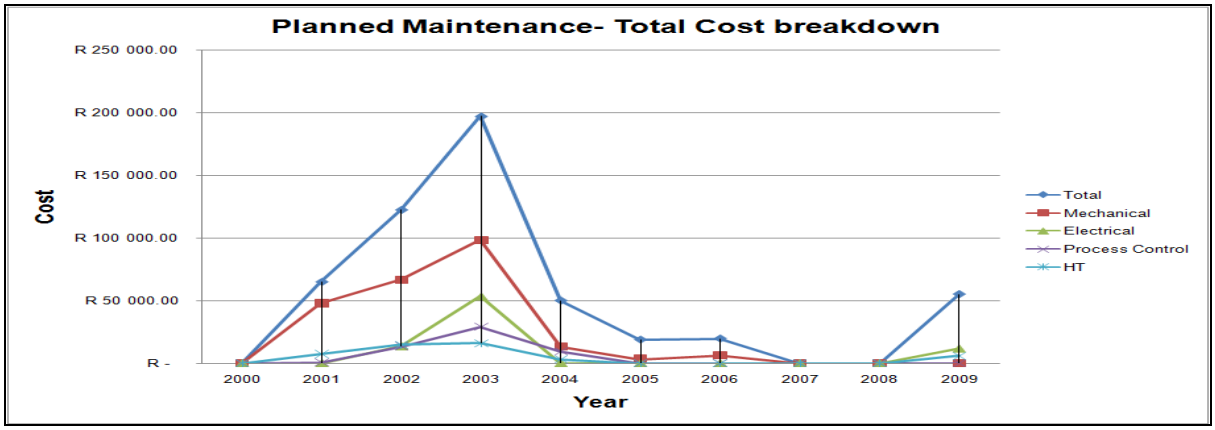


Figure 4.12: Total cost of maintenance done on major equipment

Planned jobs were very constant between 2000 and 2009, with only minor fluctuations, as Figure 4.13 indicates.

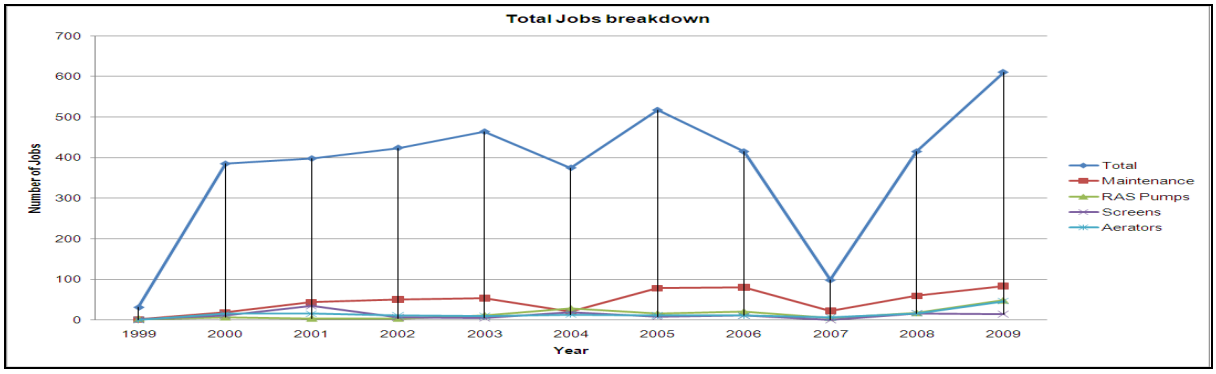


Figure 4.13: Total jobs completed for major equipment

The implementation of Green Drop certification forced municipalities and organisations to adopt asset management and ensure planning of infrastructure maintenance and processes. This is evident in Figures 4.14 and 4.15, which show that there was an average increase in planned maintenance cost from about R100 000 to more than R350 000 as a result of increased maintenance activities between 2010 and 2012.

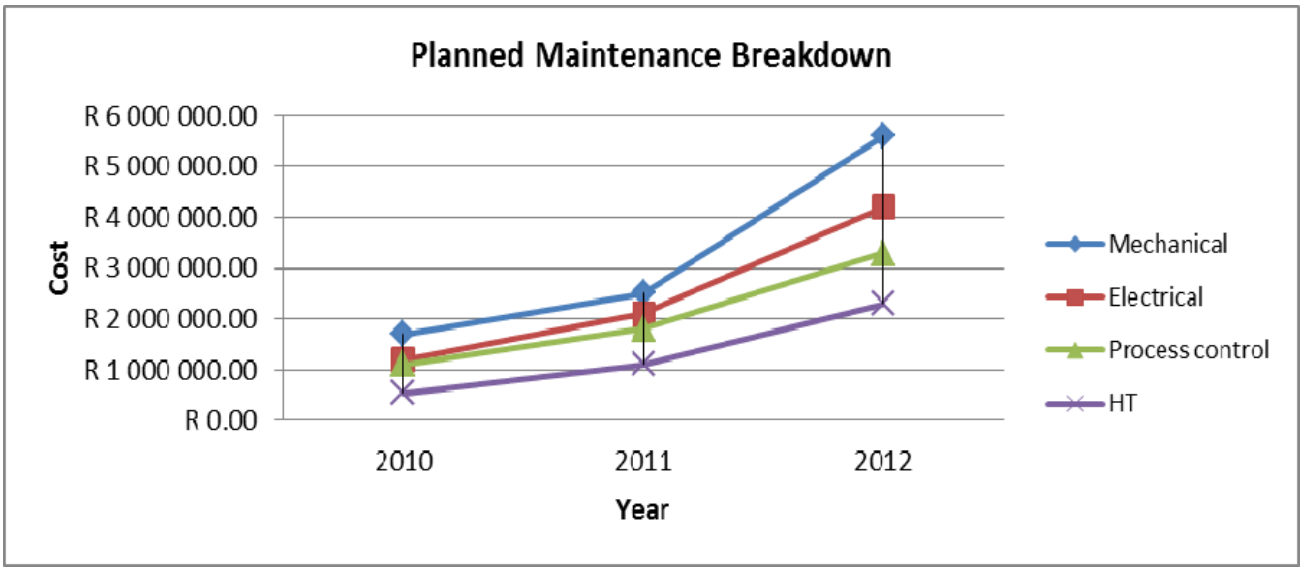


Figure 4.14: Planned maintenance

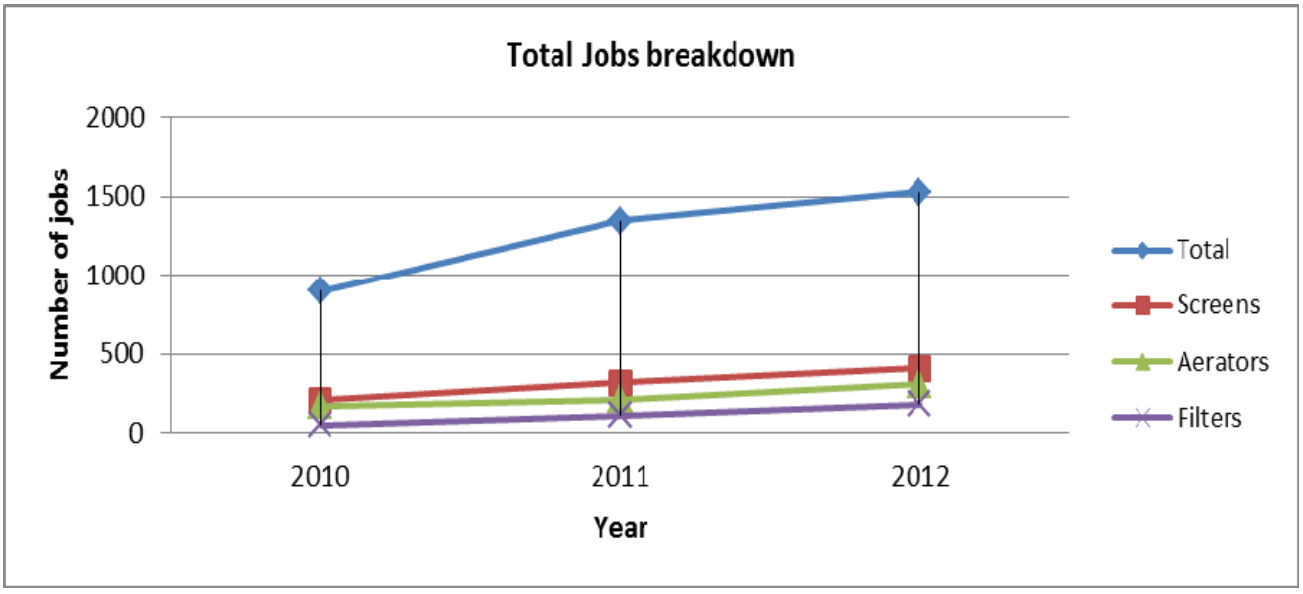


Figure 4.15: Total jobs breakdown

4.7. Delays in maintenance execution

Figure 4.16 below indicates the turnaround times of equipment, measured from the time the incident is reported to the time the fault is repaired or the equipment is back into service. The results indicate varying turnaround times. There was no proper process and agreed-upon timeframe to measure equipment downtimes. This sometimes resulted in technicians taking too long to repair equipment.

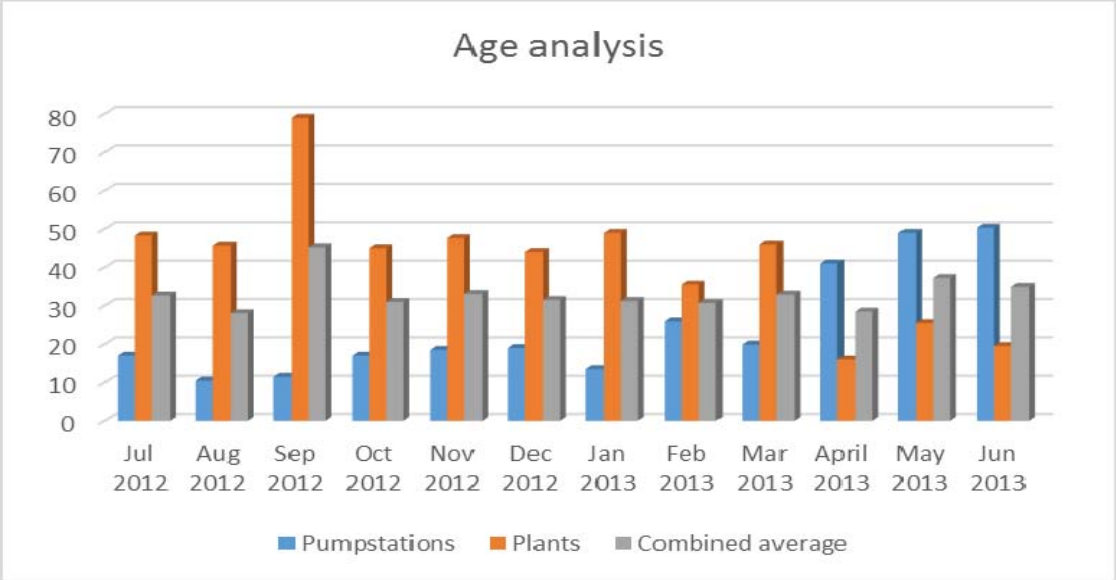


Figure 4.16: Age analysis (equipment turnaround times)

As shown in Figure 4.16, turnaround time varies between 35 and 79 days on the treatment plants while it varies between 15 and 30 days on the pump stations; the average downtime was about 30 days.

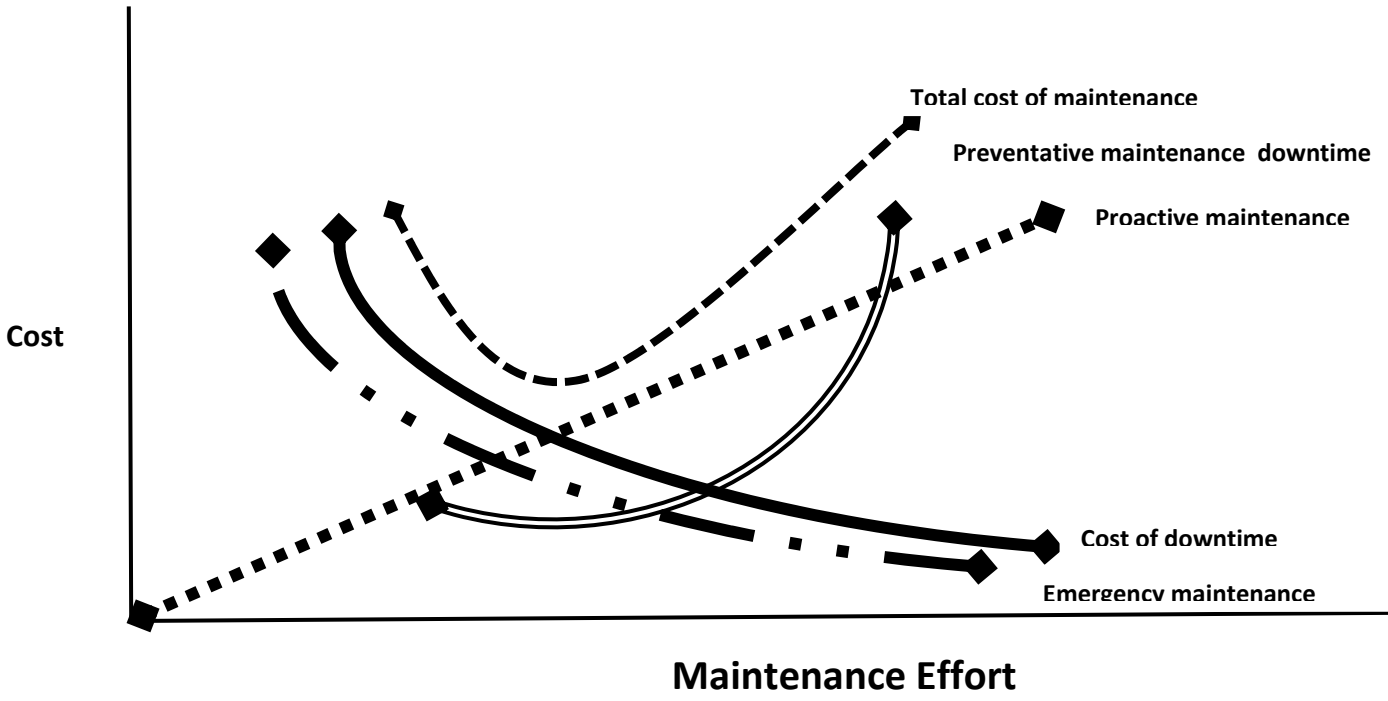
The poor turnaround times impacts negatively on the water treatment process and the ability to meet quality standards and effluent quality.

Figure 4.17 below represents the process that must be followed when developing infrastructure or an equipment profile for the entire portfolio of assets. This process ensures that infrastructure planning is based on risk criteria and the priority of assets and that it does not standardise the maintenance process as assets differ in their priority and criticality.

Source: National Treasury, 2003:24

Figure 4.17: Risk-based planning and performance measurement

Figure 4.18 below illustrates the combined effect of increased preventative maintenance as well as corrective maintenance. Initially maintenance cost is low but as maintenance efforts increase, the total cost also increases. Emergencies and downtime should then decrease, as indicated in Figures 4.18. The increase in maintenance effort can have a positive effect on the overall performance of the department and the organisation. The figure highlights the importance of a structured process of implementing an asset management strategy that is linked to organisational strategy.



Source: IMESA (2006)

Figure 4.18: Combined effort of maintenance

4.8 Chapter summary

The information provided reveal that although an asset management process was implemented at ERWAT, there were no policy guidelines or strategy alignment to ensure that the organisation's achievement with regard to asset management is reviewed strategically. The result was that asset management has become a process which is used only when it is convenient and that the contribution of the process towards achievement of the organisation's objectives is minimal. The findings show that maintenance activities linked to asset management have not been consistent and that maintenance management has largely been reactive, resulting in unplanned maintenance processes.

There is a strong indication that standardised performance measurement and service level agreements are needed to improve performance levels. In addition, constant communication between departments will assist in minimising the performance challenges identified.

CHAPTER 5: Summary, recommendations and conclusions

5.1 Introduction

The maintenance management system within asset management is a business process that facilitates handy management of work activities and ensures efficient utilisation of resources while outlining various measurements of departmental performance. The processes and procedures are classified and categorised to ensure a common understanding and approach to maintenance. This chapter presents an analysis of the findings of this study. It also recommends the best approaches to help ERWAT improve its current processes and ensure that the organisation meets the criteria for Green Drop certification.

5.2 Summary of research results

The operating environment presents various threats and opportunities that ERWAT needs to consider when developing and implementing its asset management strategy. It is clear from the findings that not all environmental and political factors were taken into consideration.

5.2.1 Strategic alignment

ERWAT's strategy did not address strategic elements of asset management. There was no mention of the policy framework or legislative framework that requires the implementation of asset management such as MFMA, National Treasury guide on capital asset management in the organisation's strategy, which means that the organisation is exposed to environmental and political risks. The asset management framework must be implemented as indicated by the National Treasury guideline (2003) as it indicates how all infrastructure assets including water and sanitation assets should be managed. The guideline also outlines that the strategic objectives and policy should reflect the organisation's objectives, principles, processes, standards and targets; however, all of these are not reflected in ERWAT's strategy.

ERWAT's asset management policy had been implemented without being approved by the Board of Directors, which entails risks for the organisation. There was no documented process to measure and evaluate performance as it was not reflected in the organisation's strategy. Also, it will not be measured through performance management by the Board, as

the Board will only measure the objectives identified, which means that it will not receive the required attention from any department.

The physical asset management strategy states that there should be alignment between organisational goals and organisational strategy. A communication strategy should be developed which outlines all communication protocols as outlined in the Green Drop requirements for the purpose of communicating and reporting the results. The key performance areas and indicators should be specific, measurable, accurate, relevant and tangible (SMART) and an information management system should be used to communicate, monitor and evaluate the results to ensure accessibility and transparency.

The technical department implemented asset management processes while other departments either did not or were using different standards. The asset management process was implemented on a convenience basis; there was no timelines to measure the progress of implementation and there was no standardisation throughout the organisation. For example, both the technical maintenance and capacity development departments were responsible for infrastructure but they were using different standards to manage it – one was using the asset management process and the other the FDP model. This proves that different strategies are applied in the same organisation to achieve one goal.

5.2.2 Asset maintenance process

There were discrepancies in the application of the maintenance process on the On Key system. There was no formalised process map that guides the application, including planned maintenance, corrective maintenance as well as the construction of new assets. On Key was basically used on an ad hoc basis because the process had not been formalised. There was no way of measuring and correcting the performance gaps. ERWAT needs to develop a process for updating the asset register, and once updated ensuring that it is constantly updated.

ERWAT's Green Drop performance was not consistent. Initially the organisation received Green Drop certification for two plants, with an average score of 65%. The following year, only one plant received Green Drop certification, but the average improved to 79.9%. The criteria for Green Drop certification, including asset management, monitoring and opera-

tions, had been a great focus. These aspects have been implemented, monitored and are being improved but the challenge for ERWAT was that these had not been approved properly. Green Drop requirements had not been included in the organisation's strategy and no performance objectives were attached to them for performance management purposes.

The findings have identified ERWAT's major challenge with regard to the failure to meet Green Drop and other compliance requirements. This is indicated in Figure 3.1, which presents ERWAT's overall daily flows against the capacity available. If the plant is operating above its design capacity, it receives about a 10% penalty. This means that for it to receive Green Drop certification (for which the plant must score 90% or above), it must score 100% on all the remaining criteria, which normally is not possible. ERWAT has to ensure that all the plants that operate above their design capacity are urgently addressed in the organisational strategy, which it currently is not.

The performance of the five major plants indicates that there was lack of consistency which impacted negatively on the overall performance of the organisation. As indicated in Figure 4.3, only Dekema was performing consistently, while the other plants fluctuated from year to year. Green Drop certification requires consistency and strict management. There was an indication that maintenance activities have improved since the implementation of the asset management process, which resulted in an increase in compliance levels and a reduction in failures. This was also reflected in the maintenance budget, which had increased significantly since the implementation of the asset management process.

ERWAT's utilisation of the CMMS is good and the office is fully resourced, but there was a disconnection between the planning office and the maintenance teams. Some work orders were open on the system while the work had been completed on the plants; others were closed while the work had not been completed. This does not give an accurate account of the reality of the situation.

Currently, On Key provides six functions. However, it was found that only two functions were fully utilised, which indicates utilisation of about 35.3% – poor for proper implementation of the asset maintenance process. The system currently is not linked to the financial and human resources systems, which creates problems for proper budgeting and budget monitoring. It also causes a delay in reports and management actions. The poor utilisations

of On Key's asset register and materials manager functions created the problem of an inaccurate asset register and inventory management. Even decommissioned equipment are still appearing on the asset register while some of the new assets are not registered on the asset register and some do not have asset identification numbers. Hopefully the linkage between On Key and the Great Planes system used by Finance will minimise this problem.

The maintenance manager function was also not properly used, which resulted in discrepancies regarding proper work closure, as well as a lack of incident reporting and management procedure. There has to be a procedure for reporting incidents to Technical Services and how these will be prioritised, managed and feedback given on the progress.

5.2.3 Asset management implementation

The asset management process requires consistent and proper management and supervision to ensure that the organisation benefits from it. Although the indication was that most of the asset management processes, including preventative and corrective maintenance, were conducted, the activities indicated an increased amount of corrective maintenance after the implementation of asset management.

There was an increased focus on maintenance planning and execution, which resulted in a reduction of failures and an increase in compliance. The findings also indicate the lack of personnel development to ensure a high level of competency and succession planning. A comparison of the activities before asset management, Green Drop implementation and the period before implementation indicates that ERWAT increased their activities in accordance with Green Drop requirements, the successful implementation of asset management process will ensure that green drop certification and compliance is sustainable.

The literature indicates how asset management and incorporating the CMMS to track and monitor the maintenance activities could be used to help the organisation achieve performance objectives. It is clear from the findings that failure to implement asset management correctly could result in performance that is not consistent and sustainable. Moreover, the challenges faced by most water companies can be addressed only by ensuring that asset management is developed and implemented correctly and that a good infrastructure audit

is done prior to implementation to ensure that all planned activities address infrastructure needs.

The asset management process forces managers to ensure that maintenance, operations and installation of equipment is planned, scheduled and executed properly. As shown in the study, ad hoc implementation of the asset management system and processes does not always produce the desired impact, and even if it shows good results those may not be consistent.

5.3 Recommendations

ERWAT needs to develop a strategy that addresses asset management and development of key infrastructure. Implementation needs to be shared by all departments as the asset management process affects them all. Such implementation should start with strategy design, followed by development of a policy framework that will guide the implementation and outline performance measurement, which should include all departmental heads as well as the accounting officer.

The infrastructure budgeting and planning should incorporate a risk management strategy as indicated by Green Drop requirements. This will ensure that all infrastructure departments are involved in prioritising and managing infrastructure in a proactive manner rather than being reactive as it is currently. Asset management requires continuous competency development, research and benchmarking against the best industries to ensure that the organisation keeps up with the changing environment. An example of this is the development and impact of ISO 55000, which is currently in an advanced stage in other countries, on the asset management system.

It is evident from the research that ERWAT needs a structured approach to ensure proper implementation of asset management. The study highlighted various deficiencies within the current processes; although there may have been visible results, these were not consistent and are not sustainable. The company needs to discard completely the old way of planning and maintaining infrastructure and adopt a complete process of asset management. This should be aligned between all relevant departments and the CMMS that should be used to support asset management should be integrated within all departments. The current infra-

structure planning and management is fragmented, indicating a lack of direction and vision as it does not support the organisational strategy. The implementation of asset management will ensure that infrastructure planning is aligned with organisational strategy. This will achieve the following:

- Similar objectives and performance deliverables between operations and technical departments
- Same infrastructure performance measurements and expectations
- Common criteria between procurement and operations to decide on criticality and risks measurements
- Assist in development of infrastructure plan
- Development of infrastructure strategy and capital budget for the organisation
- Assist in development of the asset management policy for the entire organisation
- Development and implementation of maintenance planning

5.4 Conclusions

The benefits of asset management cannot be fully realised and the impact of asset management fully appreciated if it is implemented in selected departments or selected areas of the organisation only. This study has shown that while there has been noticeable improvement in ERWAT's infrastructure performance and this has made a positive contribution, there are still many improvements needed. The implementation of asset management should be driven by the strategy of the organisation and should flow to departmental level, where each head of department should be required through performance management to implement asset management; this should be monitored and managed at the highest level of the organisation.

The findings revealed that departmental achievements do not necessarily translate into organisational excellence. This means that all departments must work within the same framework, implement the same processes and have the same objectives.

Green Drop assessment and other compliance standards are some of the key performance deliverables that emphasise asset management as a key component of infrastructure management. Such assessment can also be used to measure, monitor and manage performance on a regular basis. In addition, some of the aspects of infrastructure maintenance and objectives can be measured easily using Green Drop requirements because it requires interdepartmental communication, planning and coordination.

The current failure response plan and risk abatement plan for Green Drop assessment requires that the infrastructure plan or maintenance plan is developed using risk-based planning. This means that the infrastructure must be prioritised, planned and maintained in terms of criticality, and that maintenance plans must address and mitigate risks that have been identified for operation purposes. The challenge with this process is that infrastructure requires regular assessment. Risk planning must be based on the condition of assets, not on the risks of failure, as this leads to the development of faulty plans. Infrastructure assessment must be done regularly and continuously to ensure that it takes both condition and usage into consideration.

ERWAT's overall compliance, increase in planned maintenance and reduction in recorded plant failures may indicate the impact of maintenance processes in addressing failures and increasing compliance standards; however, the fact that there is a disconnection between planning and maintenance activities creates doubts about this impact.

There is also a need to ensure that all infrastructure management functions are integrated and coordinated in order to support the goals of the organisation. Asset management is an integrated process and all functions and processes need to support each other to ensure sustainable results.

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